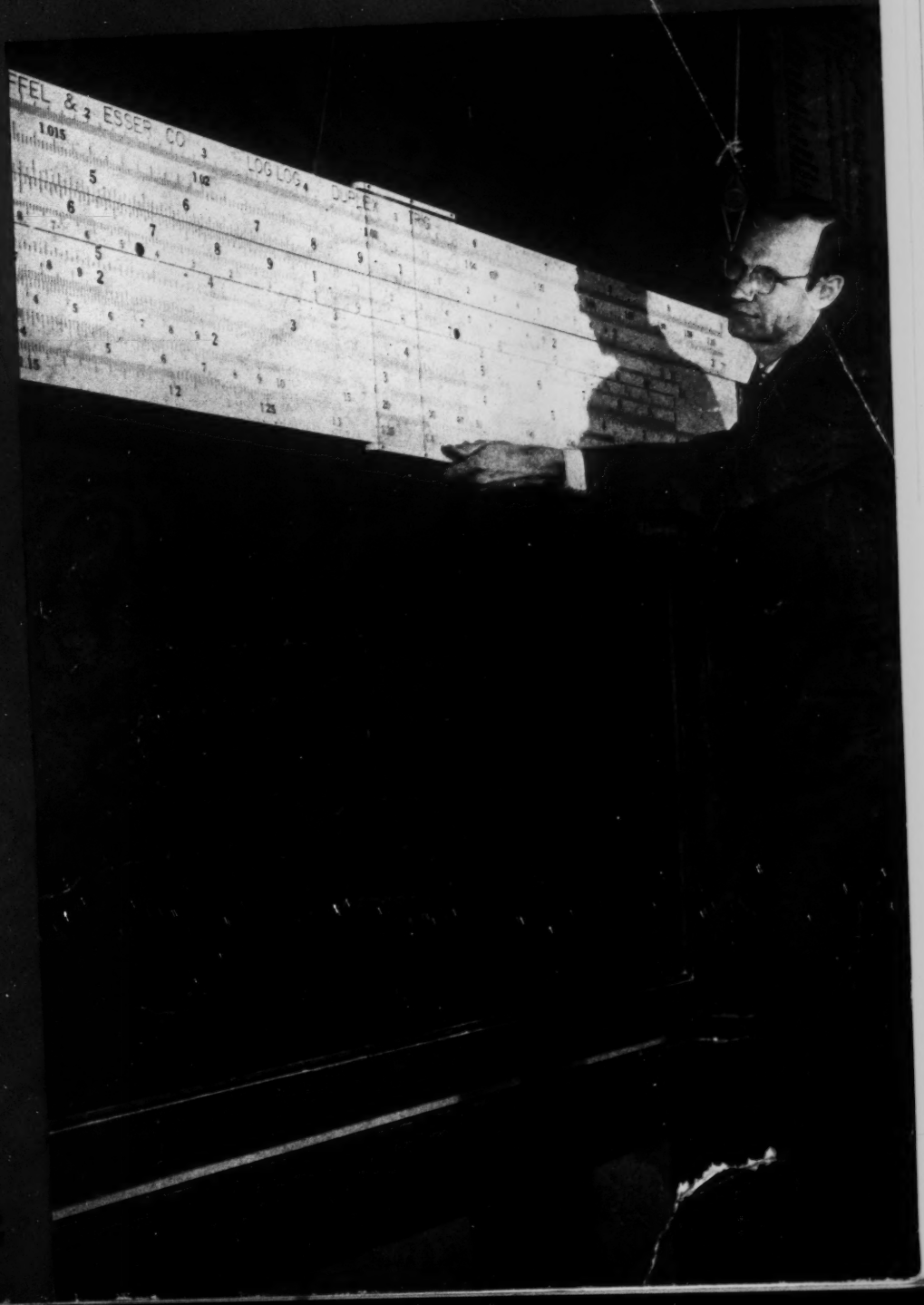
ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION

JULY 24, 1947

ONSTRUCTION
STS TO CONTINUE
T HIGH LEVELS

HIRLER CRANES
BUILD
LUESTONE DAM



...ge moves quicker than the ... new slide-rule method

Road building used to be a first-class headache

Old time road builders did their best but Mother Nature generally beat them at every turn. Then *Engineered Drainage* turned the tide and now you can build first-class roads without the headaches.

But it didn't just happen. Road builders recognized the problems and Armco Engineers cooperated with them. More than 40 years ago they began to develop drainage and other products to meet specific highway and construction needs — perforated pipe to drain subsurface water; MULTI PLATE and corrugated pipe for surface drainage, and many more. Armco Engineers whipped erosion and corrosion; speeded up installation; provided greater safety and economy at every turn.

The helpful, authoritative information that came out of these years of experience is obtainable from no other source. Here among the cumulative data of thousands of installations, as well as field and laboratory tests, may be the answer to your problems.

These are some of the reasons why you'll be time and money ahead by bringing your drainage and construction problems to Armco. From this single, convenient source you can obtain a complete range of engineered products and all the help you want in applying these products to your designs. Usually there are case histories of similar problems in every field — highway, railway, airport, municipal or industry. If it is something new, you'll want to talk it over with one of our specialized Armco Engineers.

Structural Plate Pipe & Arches★ Corrugated Metal Pipe★ Welded Steel Pipe★ FLEX-BEAM Guardrail★ Water Control Gates★ Retaining Walls★ STEELOX Buildings★ Sheeting★ Tunnel Liner★ Subdrainage Pipe★ End Sections★ Pipe Piling★ Pile Shoes★

Armco Drainage & Metal Products Inc.

OFFICES IN PRINCIPAL CITIES

ARMCO

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation, Canals, Tunnels, Railroads

Volume 139 • Number 4 JULY 24, 1947

ALBERT E. PAXTON.....*Publisher*
WALDO G. BOWMAN.....*Editor*
EDWARD J. CLEARY *Executive Editor*

•

ASSOCIATE EDITORS—V. T. Boughton, R. K. Tomlin, H. W. Hunt *(New York)*, V. B. Smith *(Chicago)*, J. R. Carr *(Cleveland)*, N. A. Bowers *(San Francisco)*, A. N. Carter *(Washington)*

ASSISTANT EDITORS—F. S. Merritt, John C. Bumstead *(New York)*; L. L. Wise *(San Francisco)*

NEWS EDITORS—E. E. Halmos, Jr. and T. D. MacGregor

STAFF ASSISTANTS—Ethel Lyon, Helen McCord, Louise Jacobson

BUSINESS NEWS—Elsie Eaves, *manager*, J. A. Mahoney, E. R. Biggerstaff, Marie W. Roessler

ENGINEERING NEWS-RECORD
Published By
McGRAW-HILL PUBLISHING CO., INC.
Publication Office:
99-129 N. Broadway, Albany 1, N. Y.
Editorial and Executive Office:
330 W. 42nd St., New York 18, N. Y.

FEATURES IN THIS ISSUE

News of the Week		53
Editorials		62
Whirler Cranes Build Bluestone Dam		64
How to Speed Up Slide-Rule Work	L. JOHNSON	70
Fiber Tubes Imbedded in Conrete Slab	F. R. SCHOFIELD	72
Triple Sedimentation Conditions Water	S. I. ZACK	73
Housing Costs Cut by Cooperation		76
Does Torque Weaken Bolts?	H. O. HILL	78
Pavement Evolution at March Field	F. KOEHM	80
St. Lawrence Estimates Revised		84
Shop-Built Tools Speed Road Test Work		86
Construction Costs to Continue High	H. A. WARD	88
Portable Echo-Sound Recorder		90
Arizona Relocates Mountain Highway		92

DEPARTMENTS

Construction Trends	49	Men and Jobs	108
Comment and Discussion	95	Elections and Activities	117
Field and Office	96	Manufacturers' Activities	121
Unit Prices	98	Manufacturers' Publications	122
New Aids	103	Construction Reports	151

Number of Copies of this issue printed 43,517

INDEX FOR VOLUME 138

An index for Volume 138 (January-June 1947) will be published during the latter part of July. Copies will be mailed to subscribers who ordered an index for Volumes 136 and 137. Subscribers who did not order a copy of that index or who have changed their address should return this coupon to

The Editor, Engineering News-Record
330 West 42nd St., New York 18, N. Y.

Name .....

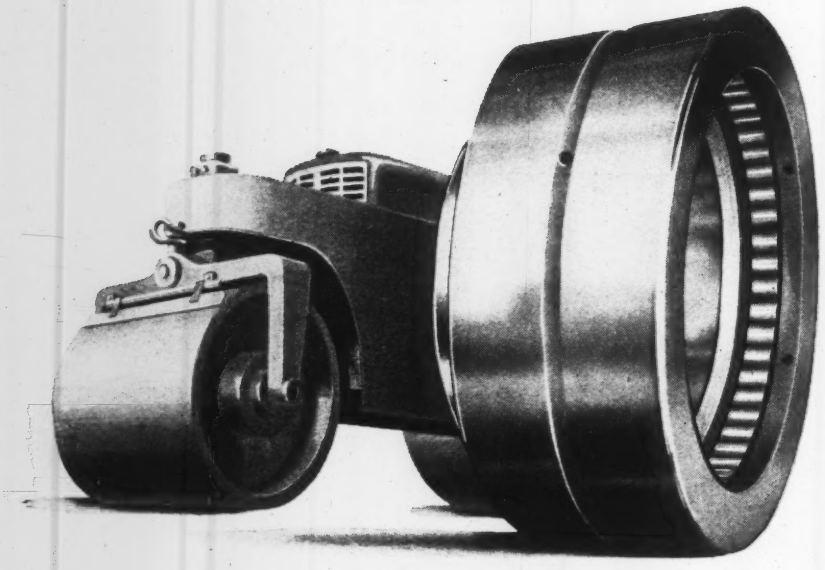
Street .....

City and State .....

ENGINEERING NEWS-RECORD. Published every Thursday. **Return postage guaranteed.** Vol. 139, No. 4. Price 35c per copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd Street, New York 18, N. Y. Subscriptions, United States and U. S. Possessions, $6.00 for one year, $9.00 for two years, $12.00 for three years. Canada $7.00 for one year, $11.00 for two years, $14.00 for three years. Latin American countries $10.00 for one year, $16.00 for two years, $20.00 for three years. All other countries, $20.00 for one year, $30.00 for two years, $40.00 for three years. Please indicate position and company connection on all subscription orders. Entered as second-class matter October 29, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in the U.S.A. Cable Address: "McGraw-Hill New York." Member A.B.P. Member A.B.C.

Copyright 1947 by McGraw-Hill Publishing Company, Inc. All rights reserved. James H. McGraw, Founder and Honorary Chairman; JAMES H. McGRAW, JR., President; CURTIS W. McGRAW, Senior Vice-President and Treasurer; JOSEPH A. GERARDI, Secretary; NELSON BOND, Director of Advertising; EUGENE DUFFIELD, Editorial Assistant to the President; and J. E. BLACKBURN, JR., Director of Circulation.

Publication office: 99-129 North Broadway, Albany 1, N. Y. Editorial and Executive Office: 330 West 42nd St., New York 18. District Managers and Branch Offices: Fred G. Hudson and L. H. Hunt, 520 N. Michigan Ave., Chicago 11; 738-39 Oliver Building, Pittsburgh; J. W. Otterson, 68 Post St., San Francisco 4; Aldwych House, London, W. C. 2, England; Washington; J. M. Spackman, New York; A. B. Cozzens, Philadelphia; E. E. Duff, Jr., Cleveland; B. F. Horn, Detroit; W. E. Donnell, St. Louis; R. N. Phelan, Los Angeles; W. G. Payne, Boston; Ralph Maultsby, Atlanta, Ga.



Smooth rolling . . .

is assured by the precision, anti-friction construction of Torrington Type NCS Needle Bearings. Sturdy races and the full complement of rollers provide dependable, low-wear operation

In heavy-duty applications . . .

for loads are evenly distributed over a large area of bearing contact surface. The compact size of NCS Needle Bearings also allows a reduction in size and weight of related parts with no sacrifice in strength.

Other advantages include efficient lubrication, low coefficient of friction for operating economy, and unit construction for easy assembly. To help your equipment perform smoothly with minimum maintenance attention, consider Torrington Type NCS Needle Bearings.

THE TORRINGTON COMPANY

SOUTH BEND 21, INDIANA TORRINGTON, CONN.

Offices in All Principal Cities

TORRINGTON BEARINGS

• NEEDLE • SPHERICAL ROLLER • STRAIGHT ROLLER • TAPERED ROLLER • BALL •

Construction Trends

The Construction Dollar's Influence on Volume

Construction costs have risen to a point where almost twice as many dollars are needed to finance construction programs as were required in 1926. For example, on the basis of 1926 as 100, the physical volume index, adjusted for the decline in the purchasing power of the dollar, was 121 in June, 1947, while the index of the dollar volume of construction was 235, or nearly double the physical volume index.

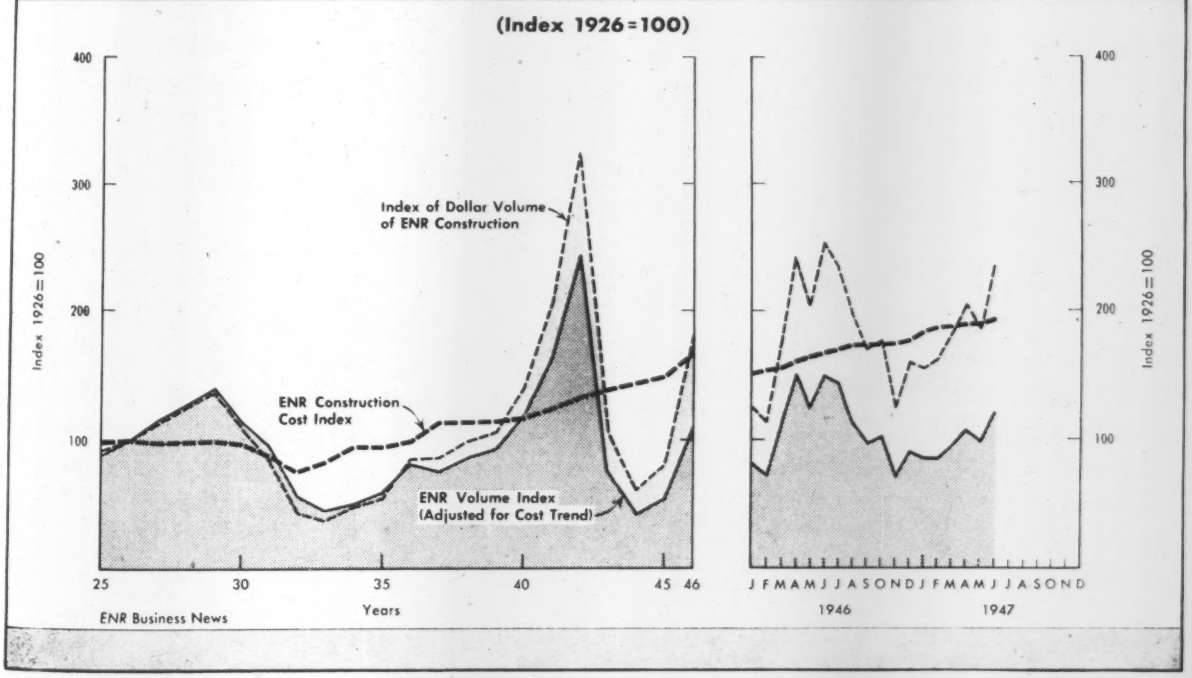
In comparing the rise in construction costs since 1935-1939, however, with the rise in costs of such items as food, clothing and housefurnishings, construction costs are not out of line. Using the Bureau of Labor Statistics' Consumer's Price Index the purchasing power of the dollar in May, 1947, the latest date available, was 53 percent of 1935-1939 values for food, 54 percent for clothing and 55 percent for housefurnishings. The purchasing power of the construction dollar based on *Engineering News-Record's* construction cost index, equaled 55 percent of 1935-39 values in July, 1947.

The post depression rise in construction costs began in 1932, when the index on the basis of 1926 as 100 reached a low of 75.46. Since that time, the cost index has made uninterrupted gains each year, with the exceptions of 1935 and 1939 when moderate declines occurred. In July, 1947, the construction cost index reached a peak of 195.41, but shows promise of stabilizing close to the present value.

The rise in construction costs in 1947, with the accompanying decline in the purchasing power of the construction dollar, caused the physical volume of construction from March through June of 1947 to drop below a year ago. The *Engineering News-Record* volume index, on the basis of 1926 as 100, declined to 99.16 for the first half of 1947 from 115.67 during the corresponding period a year ago. This was a decrease of 16.6 percent.

The index of the dollar volume of construction through June, 1947 averaged 188.17, or 1.2 percent above the index of 186.0 for the first six months of 1946.

EFFECT OF CONSTRUCTION COSTS ON CONSTRUCTION VOLUME



We're not Doing You a Favor!

In these days of critical shortages, some firms seem to consider it a favor to provide a needed product. But here at Ryerson you'll find no seller's market complex. Every inquiry is still regarded as an opportunity to serve and every order a compliment to our organization.

Prompt shipment of steel from stock is our business. When we can deliver needed steel, we're more than glad to do it. The thanks belong, not to us, but to you for letting us work with you.

That's the way we have done business for more than 104 years—through good times and bad, and that's the way we continue to operate.

Much as we'd like to handle every item on all your orders, present conditions often make this impossible. But stocks of alloys, stainless bars, seamless tubing, and many other products are in good supply at each of our twelve plants, and products or sizes out of stock today may be available tomorrow.

So contact your nearest Ryerson plant for prompt, personal service. We may not always have all the steel you need but we'll certainly do everything possible to take care of you.

Joseph T. Ryerson & Son, Inc. Steel-Service Plants at: New York, Boston, Philadelphia, Detroit, Cincinnati, Cleveland, Pittsburgh, Buffalo, Chicago, Milwaukee, St. Louis, Los Angeles.

RYERSON STEEL

'46 Record Volume Matched by '47

Heavy engineering construction at the end of the first six months of 1947 is running 1.6 percent ahead of a year ago as compared with a gain of 32.1 percent over the two-months period of 1946 at the end of February. Contract volume for the half year, 1947, however, is 16.8 percent greater than total construction volume in all of 1945. Contracts through June this year, as recorded by *Engineering News-Record*, total $2,673,865,000 compared with $2,632,186,000 for 1946.

Private contract awards for the first half of 1947 dropped 8.1 percent below 1946 while public contracts rose 18.7 percent. In the classified construction groups, public buildings showed the greatest gain, rising to $252,419,000 from the 1946 half year figure, or 54.9 percent.

At the end of June, 1947, industrial building contract awards of $388,629,000 were 26.2 percent below the corresponding period of 1946, while commercial building awards of $912,168,000 were 12.5 percent below a year ago. With the exception of earthwork and drainage contracts, which dropped 19.4 percent below the six-months period for 1946, all other types of construction rose above a year ago.

Geographically, only New England and the Far West were running below the cumulative total for the first half of 1946, declining approximately 30 percent. Other sections showed gains, ranging from 11 percent for the Middle Atlantic states to 37 percent for the Southern states.

New construction proposed during the first half of 1947, as recorded by *Engineering News-Record*, totals $3,976,387,000, a decline of 1.4 percent from the corresponding figure for 1946. New private construction proposed in this period, however, rose 33.5 percent over 1946, as the result of a gain of 56.3 percent in industrial building. With the exception of bridges, all other types of proposed classified construction declined as compared with the corresponding six-months period of 1946.

ENGINEERING CONSTRUCTION REPORTED BY ENGINEERING NEWS-RECORD—FIRST HALF 1947

Minimum contracts reported, Waterworks, excavation, drainage and irrigation, $22,500; other pubic works, $40,000; industrial buildings, $55,000; other buildings, $205,000.
(Thousands of Dollars—000 omitted)

States	PUBLIC WORKS CONTRACTS					BUILDINGS				Federal Gov't. Work	All Construction		1947 Total 26 Weeks	1946 Total 26 Weeks	% Change 1946 to 1947
	Water-works	Sewer-age	Bridges	Earthwork Irr.-Drain.	Streets and Roads	Industrial	Commer-cial	Public	Un-classified		Private	Public			
Maine	.....	.....	673	.....	785	.....	.....	.....	14,306	14,306	.....	15,764	15,764	13,480	+17
New Hampshire	.....	.....	640	.....	194	.....	.....	67	.....	67	.....	901	901	5,835	−85
Vermont	.....	.....	66	.....	1,895	.....	.....	320	.....	852	.....	2,281	2,281	4,077	−44
Massachusetts	1,344	942	839	3,684	3,097	1,297	3,010	2,558	2,978	3,650	4,427	15,322	19,749	79,150	−75
Rhode Island	62	.....	40	186	137	1,462	9,870	1,097	322	1,073	11,462	1,714	13,176	7,775	+69
Connecticut	246	246	4,422	1,499	3,884	16,783	19,922	4,897	699	1,959	37,255	15,343	52,598	49,731	+6
New England	**1,652**	**1,188**	**6,680**	**5,369**	**9,992**	**19,542**	**32,802**	**8,939**	**18,305**	**21,907**	**53,144**	**51,325**	**104,469**	**160,048**	**−35**
New York	1,493	5,486	2,496	7,306	21,695	9,698	84,860	52,673	18,402	37,420	97,508	106,601	204,109	169,175	+21
New Jersey	104	55	3,954	1,964	2,867	15,375	58,215	3,690	1,306	4,072	74,149	13,381	87,530	42,405	+106
Pennsylvania	3,168	10,369	2,415	464	37,731	64,143	169,673	9,966	9,277	5,457	240,154	67,052	307,206	296,662	+4
Maryland	9,797	891	1,174	973	3,015	1,816	12,614	2,832	2,785	3,258	14,578	21,319	35,897	50,112	−28
District of Columbia	162	443	2,704	19	5,225	624	3,879	923	1,033	450	5,303	9,709	15,012	12,536	+20
Delaware	355	73	145	120	1,288	5,203	9,456	198	40	198	14,699	2,179	16,878	29,558	−43
Middle Atlantic	**15,079**	**17,317**	**12,888**	**10,846**	**71,821**	**96,859**	**338,697**	**70,282**	**32,843**	**50,855**	**446,391**	**220,241**	**666,632**	**600,448**	**+11**
Virginia	856	1,994	5,849	888	12,489	1,660	6,231	3,592	12,385	11,051	14,450	31,494	45,944	25,514	+80
West Virginia	675	.....	1,854	.....	5,298	1,474	600	418	12,327	473	14,344	8,302	22,646	15,039	+51
North Carolina	1,272	245	2,005	642	13,434	2,587	14,189	2,585	964	2,075	17,388	20,535	37,923	40,478	−6
South Carolina	904	317	1,562	2,037	7,071	4,259	7,439	2,359	1,375	5,055	12,291	15,032	27,323	27,267	+0.2
Georgia	603	806	1,500	2,228	2,701	7,072	27,823	4,023	3,161	4,529	37,181	12,736	49,917	69,265	−28
Florida	997	1,022	2,947	2,212	9,857	5,074	50,969	11,298	6,621	5,305	58,229	32,768	90,997	34,271	+166
Alabama	776	430	932	943	8,314	3,397	11,532	3,133	6,228	2,295	18,810	16,875	35,685	51,856	−31
Mississippi	594	271	2,171	15,612	12,334	1,202	2,448	1,949	1,113	16,420	3,835	33,859	37,694	10,525	+258
Louisiana	283	355	2,519	7,955	4,452	1,123	6,426	2,361	3,320	7,248	9,860	18,934	28,794	22,122	+30
Kentucky	69	126	607	39	12,793	3,361	6,095	3,982	21,621	15,901	16,077	32,616	48,693	23,485	+107
Tennessee	824	754	64	613	12,107	3,074	16,114	5,130	3,013	1,318	21,651	20,042	41,693	20,609	+102
Southern	**7,853**	**6,320**	**22,010**	**33,169**	**100,850**	**34,283**	**149,866**	**40,830**	**72,128**	**71,670**	**224,116**	**243,193**	**467,309**	**340,431**	**+37**
Ohio	2,133	1,223	890	632	11,247	14,837	42,528	6,387	2,646	1,235	59,535	22,988	82,523	94,198	−12
Indiana	912	359	1,147	1,044	3,327	7,800	7,225	1,900	2,400	380	16,825	9,289	26,114	31,813	−18
Illinois	1,520	3,256	3,429	21,028	16,956	33,770	18,461	13,048	24,867	22,925	63,992	72,343	136,335	92,899	+47
Wisconsin	1,144	4,213	806	415	9,877	11,164	3,724	2,901	22,145	2,166	34,151	22,238	56,389	36,197	+56
Michigan	777	3,199	4,407	683	5,316	8,609	3,570	6,306	18,286	1,065	29,607	21,546	51,153	54,233	−6
Middle West	**6,486**	**12,250**	**10,679**	**23,802**	**46,723**	**76,180**	**75,508**	**30,542**	**70,344**	**27,771**	**204,110**	**148,404**	**352,514**	**309,340**	**+14**
Minnesota	626	768	400	353	10,630	7,938	2,659	3,429	2,008	75	12,265	16,546	28,811	35,694	−19
Iowa	121	379	2,671	763	8,457	6,881	705	3,013	662	1,302	8,020	15,632	23,652	52,899	−55
Missouri	469	295	3,413	480	7,935	9,595	8,142	8,607	4,520	9,720	22,171	21,285	43,456	59,815	−27
Arkansas	432	132	1,877	30,511	7,067	3,950	820	196	12,960	31,574	16,855	41,090	57,945	15,093	+284
North Dakota	172	98	.....	.....	3,802	485	501	.....	1,853	1,645	1,194	5,717	6,911	11,742	−41
South Dakota	204	409	56	843	3,381	1,013	260	2,847	2,224	6,033	1,366	9,871	11,237	3,896	+188
Nebraska	79	.....	483	125	4,728	1,592	1,000	4,016	4,901	2,007	6,342	10,582	16,924	10,861	+56
Kansas	679	1,854	3,147	227	10,941	8,770	2,277	3,842	20,737	1,980	31,373	21,101	52,474	32,588	+61
Oklahoma	1,538	3,208	1,244	2,962	4,214	3,900	2,102	5,218	4,261	4,520	8,662	19,985	28,647	39,054	−27
Texas	3,972	8,603	2,045	5,865	32,314	66,534	74,681	15,332	64,956	11,594	199,501	74,801	274,302	227,511	+21
Montana	100	79	.....	408	1,280	1,102	900	373	2,035	3,079	2,002	4,275	6,277	8,212	−24
Wyoming	.....	57	40	1,186	3,911	3,500	.....	772	9,989	1,927	13,468	5,987	19,455	14,488	+34
Colorado	.....	47	358	11,139	900	4,255	.....	4,706	6,683	16,364	10,298	17,790	28,088	13,929	+102
New Mexico	60	.....	.....	1,025	3,975	190	.....	5,335	7,979	13,295	1,149	17,415	18,564	8,970	+107
West of Miss.	**8,452**	**15,929**	**15,734**	**55,887**	**103,535**	**119,705**	**94,047**	**57,686**	**145,768**	**105,115**	**334,666**	**282,077**	**616,743**	**534,752**	**+15**
Idaho	.....	.....	.....	1,396	2,819	220	282	883	1,501	2,473	502	6,599	7,101	12,158	−42
Utah	414	66	61	220	1,720	1,470	341	645	3,035	685	4,435	3,537	7,972	5,230	+52
Arizona	1,513	.....	155	590	907	.....	750	2,219	1,223	3,862	920	6,437	7,357	27,836	−74
Nevada	.....	.....	.....	86	1,765	135	205	387	.....	248	340	2,238	2,578	6,782	−62
Washington	4,129	1,477	3,180	3,896	9,181	6,208	27,841	15,147	4,275	9,288	34,394	40,940	75,334	64,852	+16
Oregon	340	1,275	909	9,137	7,351	3,361	5,215	3,986	2,704	13,174	9,882	24,396	34,278	110,324	−69
California	9,709	8,349	9,490	12,542	21,521	30,666	186,614	20,873	31,814	24,890	229,535	102,043	331,578	459,985	−28
Far West	**16,105**	**11,167**	**13,795**	**27,867**	**45,264**	**42,060**	**221,248**	**44,140**	**44,552**	**54,620**	**280,008**	**186,190**	**466,198**	**687,167**	**−32**
U. S. 1947 (26 weeks)	**55,627**	**64,171**	**81,786**	**156,940**	**378,185**	**388,629**	**912,168**	**252,419**	**383,940**	**331,938**	**1,542,435**	**1,131,430**	**2,673,865**	.....	.....
U. S. 1946 (26 weeks)	46,249	45,880	63,937	194,714	358,836	526,915	1,042,741	162,959	189,955	313,702	**1,678,739**	**953,447**	.....	**2,632,186**	.....
% Change '46 to '47	**+20**	**+40**	**+28**	**−19**	**+5**	**−26**	**−13**	**+55**	**+102**	**+6**	**−8**	**+19**	.....	.....	**+2**
Canada, 1947	5,095	3,194	4,351	4,956	24,897	83,294	30,849	38,777	23,203	.....	**124,393**	**94,223**	**218,616**	.....	**+32**
Canada 1946	2,688	3,912	1,019	805	16,610	67,467	29,121	27,859	16,058	.....	**107,988**	**57,551**	.....	**165,539**	.....

You Profit Three Ways

with

TRIPLE-THRIFT
ATLAS HIGH-EARLY CEMENT

SAVES DAYS

Usually produces serviceable concrete in one-third to one-fifth the normal time.

SAVES DELAYS

Steel work and other operations may be moved ahead an equivalent length of time.

SAVES DOLLARS

Often form costs are reduced by earlier stripping and re-use. Protection and curing time is cut.

ENR-H 49

Send for further information. Write to Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, New York.

Triple-Thrift **ATLAS**

HIGH-EARLY CEMENT

SAVES DAYS, DELAYS AND DOLLARS

OFFICES: Albany • Birmingham • Boston • Chicago • Cleveland • Dayton • Des Moines • Duluth • Kansas City • Minneapolis • New York • Philadelphia • Pittsburgh • St. Louis • Waco

"THEATRE GUILD ON THE AIR"— *Sponsored by U. S. Steel Subsidiaries — Sunday Evenings — September to June — ABC Network*

News of the Week

ENGINEERING NEWS-RECORD • JULY 24, 1947 • VOLUME 139 • NUMBER 4

President asks Congress to speed flood protection

Special message asks for $250 million in addition to funds in regular appropriations, chiefly for flood-control projects of the Army Engineers and largely in the Mississippi River basin

President Truman has made a special request to Congress to supply $250,000,000 for the Corps of Engineers, the Bureau of Reclamation, and the Department of Agriculture to advance a comprehensive flood-control plan for the Mississippi River basin. This request is in addition to the flood-control funds in the appropriation bills for these agencies now being acted upon by Congress.

In making his request the President left the door open for the development of valley authorities in the basin.

$237,000,000 for Army Engineer work

A total of $237,000,000 is requested for the Army Engineers, $10,000,000 for the Reclamation Bureau, and $3,000,000 for the Soil Conservation Service of the Agriculture Department.

The fund for the Army Engineers supplements a civil-works bill (H.R. 4002) providing a total of $252,000,000 for flood control and rivers and harbors throughout the country as passed by the House July 2 (*ENR* July 10, vol. p. 22). This bill, which is expected soon to be reported out by the Senate Appropriations Committee, provides $24,500,000 for general flood-control work on the Mississippi and its tributaries. It also supplies funds for several large dams in the Mississippi basin (*ENR* July 3, 1947, vol. p. 11).

Mississippi River work

Of the new request for the Army Engineers, $177,000,000 is for continuation of work on 24 reservoir projects and 34 local protection projects now under way and for the initiation of construction of 13 additional dams and 31 local protection jobs. In addition, $50,000,000 is sought for the Mississippi and its tributaries, and $10,000,000 for river-and-harbor work on the Missouri between Sioux City and the river's mouth.

A total of $30,686,000 of work is planned in the upper Mississippi area. Largest jobs in this are: Degognia and Fountain Bluff levees in Illinois, $1,300,000; levees at East St. Louis, Ill., $1,500,000; Farm Creek reservoir, in Illinois, $3,400,000; Red Rock reservoir below Des Moines, Iowa, $4,000,000; Coralville reservoir in the Iowa City area $2,000,000; Carlyle reservoir in Illinois, $1,400,000; Joanna reservoir in Missouri, $3,800,000; work on the Sny project in Illinois, $2,000,000; Perry County (Mo.) drainage job, $1,800,000; and Preston, Ill., levee project, $1,500,000.

A fund of $11,829,000 is sought for work in the Red-Ouachita river basin. This total includes $6,000,000 for the Red River below Denison Dam, including three reservoirs; $2,800,000 for Blakely Mountain reservoir in Arkansas; and $1,400,000 for the Narrows project in Arkansas.

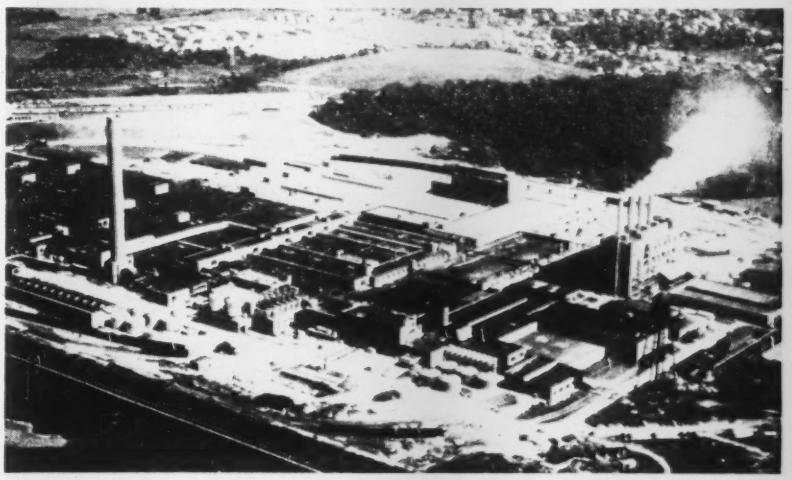
For the Arkansas-White River basin over $30,000,000 is wanted. This includes $4,800,000 for Bull Shoals Dam in Arkansas, $3,000,000 for Fort Gibson in Oklahoma, $3,000,000 for Eufaula reservoir in the same state, $2,500,000 for Hula reservoir, also in Oklahoma, and $3,000,000 for the Water Valley reservoir in Arkansas.

Funds for Ohio and Missouri Basins

Projects in the Ohio basin total over $44,000,000. These include: Center Hill Dam, $7,900,000; Wolf Creek, $7,300,000; Conemaugh, $3,100,000; Bluestone, $2,850,000; Delaware reservoir, $2,400,000; and Louisville, Ky., $2,350,000.

Requests for the Missouri River basin total above $58,000,000, including $14,750,000 for Garrison reservoir, $11,350,000 for Fort Randall, $7,125,000 for work in the Kansas City area, $7,500,000 for the Harlan County project, $9,000,000 for Missouri River levees, and $6,000,000 for the Oahe reservoir in South Dakota.

(*Continued on page* 54)



***World's Biggest Rayon Plant**—Recently completed at Front Royal, Va., is this rayon mill of the American Viscose Corp. The $30,000,000 plant, additions to which were designed and built by the Rust Engineering Co., Pittsburgh, Pa., is expected to triple production of rayon tire yarn and rayon staple yarns.*

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Highways—A survey is being made of *Kentucky's* highway system, especially in connection with rural road work. . . *Utah's* highway department is endeavoring to make the best use of road construction funds now available. Ray H. Leavitt, commission chairman, said that until more money is available his department will build roads entirely of bituminous material instead of using a bituminous-concrete combination. . . Over 200 miles of construction work and 11 bridges and culvert structures have been placed under contract by the *South Dakota* State Highway commission during the first six months of 1947. . . A total of $1,168,557 in highway and bridge maintenance bids was received by the *Indiana* State Highway Commission July 8. . . Gov. James H. Duff of Pennsylvania vetoed a bill authorizing a 4-state compact to plan extension of the Pennsylvania Turnpike westward to the Indiana-Illinois border, but suggested the General Assembly's continuing research agency—the joint state Government Commission—might look into the subject.

Construction—U. S. Surgeon General has approved a $25,000,000 community hospital plan for *Indiana* whereby 28 communities will be aided in erecting hospitals. . . J. I. Case Co. will erect a $110,000 steel storage yard at *Rock Island, Ill.* . . Chevrolet division GMC will build a large parts plant at *Parma, Ohio.* . . University of Kentucky, *Lexington*, will spend $4,700,000 in buildings and additions. . . Cities Service will build a $20,000,000 plant at *Lake Charles, La.* . . A laboratory for the Sterling-Winthrop Research Institute will be built at *East Greenbush, N. Y.* Mutual Life Insurance Co. will invest about $3,000,000 in it. . . Chesapeake & Potomac Telephone Co. will build a $5,000,000 office building at Thomas Circle, *Washington, D.C.* . . Construction has started on a $1,250,000 ion accelerator building, first unit of the University of Chicago's program for research in nucleonics at *Chicago.* . . Don M. Casto announced the ultimate construction of four shopping centers in *Columbus, Ohio*, to cost $6,000,000. . . Preliminary work has begun on a $15,000,000 celanese pulp mill at *Port Edward, B.C.*, by the Celanese Corp. of America. . . A $1,500,000 office and plant building in *Dallas, Tex.*, will be started next year by the Coca-Cola Bottling Co. . . A $180,000 modernizing job at the plant of the Standard Ultramarine Co. at *Huntington, W.Va.*, is reported by the Rust Engineering Co. . . A $418,000 building program for agricultural branch schools and a students' health service building is announced by the University of Minnesota, *Minneapolis.* . . A permanent apron building to cost $3,000,000 is among additional construction planned at the Logan International Airport, *East Boston, Mass.* . . A $300,000 power plant has been contracted for by Anheuser-Busch, Inc., at *St. Louis, Mo.* . . *Philadelphia, Pa.*, has abandoned plans for construction of air terminal buildings at the Southwest Airport scheduled to cost $20,000,000 and will instead expend only $7,000,000. J. Victor Dallin, chief of the City's Bureau of Aeronautics and Director of Public Works Thomas Buckley announced that Carroll, Grisdale and Van Alen, Philadelphia architects, had been commissioned to draw up the new plans.

Water supply and sewers—The Minnesota State Water Pollution Control Commission this month granted permits to 26 *Minnesota* cities for sewage disposal systems and improvements. . . Priorities on a comprehensive sewer rehabilitation program extending over 10 years are being studied at *Indianapolis, Ind.* . . A proposed sewer loan of $300,000 will be voted on in *Harrisburg, Pa.* Sept. 9. . . A referendum has just been called at Durham, N.C., for Oct. 4 on the proposed issuance of $4,500,000 worth of bonds for capital improvements in the city, including expansion of the water and sewer services. . . A contract for a sewer extension project has been awarded by the city council of *Clarksville, Ark.*, to Forsgren Bros. of Ft. Smith, Ark. for $86,750. Work is scheduled to begin Aug. 15. . . Charles B. Bacon has been elected chairman of the *Middletown, Conn.*, Water Study Committee, organized to look into the city's water supply problems. Consulting engineers will be sought for a survey of the system and recommendations will be made.

To speed flood control

(*Continued from page* 53)

The $50,000,000 requested for the Mississippi and its tributaries is wanted for levees, bank stabilization, and dredging on the main stem of the lower Mississippi and the lower reaches of the White, Arkansas, and Red rivers within the alluvial valley. With this fund, authorized reservoirs, levees, and drainage works on the St. Francis, Yazoo, Tensas, and Atchafalaya basins on the lower river would also be constructed.

Funds for irrigation

The $10,000,000 requested for the Bureau of Reclamation is in addition to the construction funds contained in this agency's general appropriation bill for next year already passed by both the House and Senate. The former approved about $9,500,000 of construction in the Mississippi basin that incorporates flood-control work (*ENR* April 24, vol. p. 703), while the Senate has approved nearly double this amount for jobs offering flood-control benefits (*ENR* June 19, vol. p. 971).

Largest bureau funds requested are Boysen Dam, $1,000,000; Enders Dam, $1,000,000; Canyon Ferry Dam in the upper Missouri basin, and Mission and Moorehead dams in the Yellowstone basin, $900,000 being requested for each of these jobs. Most of the bureau money would be spent for starting new projects.

Most of the $3,000,000 requested for the Soil Conservation Service would be used for improvements in the basins of the Little Sioux River in Iowa, the Washita in Oklahoma, and the Little Tallahatchie-Yazoo River basin in Mississippi.

Construction plans are ready

In making his request for a comprehensive program for the Mississippi valley, the President revealed that Congress had already authorized over three and one half billion dollars of flood control construction in the basin. The Army Engineers report that they have plans sufficiently advanced on this program that all of the money now sought could be obligated this year by the award of construction contracts on essential work.

The Bureau of Reclamation also reports that of the 93 dams it is authorized to construct in the Missouri basin, 46 projects embracing flood control benefits are planned sufficiently that early start of construction of these structures would be possible. The bureau already has work underway on Kortes, Angostura, Enders, and Boysen dams, which all provide some flood control protection.

The President left open the question of the desirability of creating valley authorities. He said, "this plan does not change the desirability of the ultimate establishment of valley authorities, but the urgency of the flood problem is such that we must take necessary steps to expedite this program without awaiting determination of the administrative pattern for the various regional valley development programs."

ASCE to survey scientific manpower; backs universal military training

Recommendations for efficient use of engineers in national emergency to follow study of membership war experience

In cooperation with the War Department and other federal agencies, the American Society of Civil Engineers will make a survey of its 22,000 members to compile data disclosing how engineers can be most useful to the nation in a national emergency. Decision for this action was made by the society's Board of Direction at the 75th annual convention at Duluth, Minn., July 18-20. The survey will be made through a questionnaire covering education, civilian experience in military departments or war agencies during the last war, employment and occupational status, utilization of engineering experience in civilian wartime employment, as well as military service, and other factors designed to assist in cataloging engineers for potential emergency service.

The board also took steps to back universal military training, instructing Wm. H. Carey, executive secretary, to "take all proper action available to the society to secure the passage of legislation providing for universal military training that is in substantial accord with the recommendation of President Truman's Special Committee."

Dues raise goes to ballot

The controversial question of raising all corporate member dues $5 a year, equalizing the dues of juniors, and enfranchising juniors will be submitted to the membership by letter ballot, according to authorization given by delegates attending the convention's business session. Little discussion from the floor preceded the authorizing vote. Approval by the membership would amend the society constitution in respect to dues and letting junior members vote but not hold office.

Engineers and world problems

In addressing the opening session, E. M. Hastings, president of the society, urged engineers to emerge from the "confines of a purely technical life and of purely technical thinking to assume leadership in national and world affairs by providing non-political, unbiased, factual and analytical thinking of which the engineer is capable. We engineers cannot be content to wait for political diplomats to solve the problems; we must put our talents to work and enter whole-heartedly into the tasks of democracy that are now before us. The day is here when the creative mind of the engineer must be used for the revitalization of the world, if we are to work our way out of the confusion that is almost universal."

Declaring it is not necessary to wait for power politics before we go to work toward building a new and better world, Mr. Hastings said further: "Our profession has contributed so many magnificent things conceived, designed and constructed for the comfort and welfare of mankind. Now that we can see the magnitude of the destruction wrought by the last war, should we not face the future with a determination that such things shall not happen again? We should make our position so strong, so just and so tempered with realistic generosity that we would gain the respect of the world. Such respect cannot be purchased from foreign nations with dollars."

R. E. Dougherty, vice president of the New York Central System, was nominated for president of the ASCE at the Duluth meeting.

Hastings also hailed the Taft-Hartley Act as "emancipation of engineering employees from compulsion to join heterogeneous labor organizations. Professional employees now have the right to form bargaining groups made up entirely of professional men, or to join with nonprofessional employees, if that is their desire."

Costs feature technical sessions

The theme of construction costs was woven through most of the technical sessions. Forrest W. Parrott, national president, Associated General Contractors of America, stated that while construction costs apparently have reached the peak and are becoming stabilized, at best only a slow decline in costs can be expected, and prewar prices will probably never return. Yet buyers are resisting current construction prices, which represent increases comparable to those in other industries, in vain hopes of a sudden and drastic drop, he declared.

Mr. Parrott urged engineers to design for economical construction procedure, to design for utmost use of mechanized equipment, to cut out expensive, non-essential frills, and to eliminate as much as possible requirements for hand-labor work. He cited as an example his firm's refusal to bid recently on a bridge in a western state where complicated formwork on what could have been a simple structure would run the cost of concrete up to $275 per cu. yd.

In a paper on cost control of construction projects, A. O. Babb, U. S. Bureau of Reclamation, Washington, stated, "If the construction industry, as a group, is to have any effect on our economy and is not going to simply sit back and take a gambling competitive position with each other, it must, through cost analysis and control, keep the slope of the construction cost index just a little better than the others. Contractors today are not competing with each other for jobs nearly as much as they are competing for dollars with other industries." He compared cost controls with "the diagnostician's report before the surgeon begins to operate", and said such procedure guarantees accurate engineers' estimates and up-to-the-minute accounting records that truly reflect the physical progress of the work.

Building research needed

J. C. Stevens, consulting engineer, Portland, Ore., urged a building research program that would seek technological improvements to increase efficiency and lower costs. "Improved methods and materials offer an effective answer to the charge that the construction industry is pricing itself out of the market," he said.

Papers by Col. Dilbert H. Freeman and Col. W. W. Wannamaker, U. S. Corps of Engineers, outlined development work in the Missouri River Basin and at Garrison Dam, respectively. Both stressed the economics of the development, particularly in reference to the recent mid-west floods.

W. W. Horner, St. Louis consulting engineer, advocated substitution of a national water policy for present "piecemeal development of water programs to

(Continued on page 57)

HIGHLIGHTS OF MUNICIPAL DEVELOPMENTS

Digested from reports by Engineering News-Record correspondents and the McGraw-Hill World News Bureau

Philadelphia awards contract for Market Street subway extension —Atlanta contracts for superhighway survey—Indianapolis wants a municipal parking commission—Baltimore seeks survey for its proposed municipal stadium

The Department of City Transit, Philadelphia, Pa., has awarded a contract for $6,539,950 for extension of the Market Street subway highspeed line from 32d to 36th sts. to the George H. Flinn Corp., New York City.

The project includes a parallel subway for the 4-block stretch on Ludlow Street just south of Market for use by subway-surface trolley cars.

Lawrence Costello, acting director of the department said the low bid was $3,183,893 below the offer of the Pennsylvania Subways Corp. which submitted the high bid among five bidders.

The city studied the submitted bids thoroughly because of the wide disparity between the low and high bids. The Flinn organization's bid met all specifications.

In announcing the award, first step in the extension of the subway high speed line to 46th Street in West Philadelphia, Mr. Costello estimated that 30 days will be required for preliminary work. The contract must be completed within two years from the time the work starts.

The parallel subway in Ludlow Street, will provide facilities for the further extension of subway-surface lines with the southbound going below surface at 36th Street, connecting with Woodland Avenue and northbound lines linked to Lancaster Avenue.

Completion of a missing link between 20th and 23d streets is the next step planned. A 4-track subway was built under the Schuylkill River on the line of Market street more than 15 years ago and has never been used. Third step of the project will be the extension of the subway from 36th to 46th street.

The work will be financed from an $8,000,000 item in the $78,000,000 loan authorized by voters.

A tremendous engineering task is involved in shoring the present elevated structure on Market street which for the entire area has east and westbound trolley tracks along the street level and in addition is used by vehicular traffic.

The present elevated structure, Director Costello said must be shored up while the subway work is in progress so that it can operate uninterruptedly and highspeed service continued as at present while the subway is being constructed. The elevated line will be torn down as far west as 46th Street after the new subway is completed.

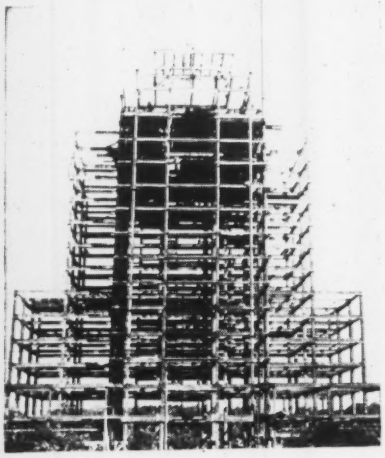
A new subway station will be built at 40th Street replacing the elevated station. The present station at 46th Street will be retained.

Atlanta superhighway

A contract for preliminary surveys on 15 miles of a north-south super highway across Atlanta, Ga., has been signed by the Georgia Highway Department and Robert and Co. engineers. Warren Neel, deputy highway director, estimated that the survey can be completed in a few months and actual construction on the first section to be started early next spring.

The multi-million dollar project is the key to a new master highway plan for Atlanta. The expressway will be six lanes wide with some parts depressed below ground level. It will include a series of grade separations and will have modified limited access.

The first project is expected to cost approximately $10,000,000.



***Welded Skyscraper**—Said to be one of the tallest buildings ever erected by welding, the 14-story Herman Professional Building will be a part of a group of structures forming the Texas Medical Center at Houston, Texas. Some 1,400 tons of structural steel were used in the building. Linbeck and Dederick Construction Co., Houston, are general contractors. (See ENR July 10, vol. p. 22). Architects are Kenneth Franzheim and Hedrick and Lindsley, of Houston.*

Indianapolis parking

Legislation may be drafted for submission to the 1949 Indiana General Assembly to create a commission with authority to issue bonds to finance construction of municipal parking facilities. This would enable the city of Indianapolis to finance construction of four multiple-level municipal parking facilities adjacent to the downtown area, as recommended by the City Plan Commission. The present law authorizing operation of municipal parking areas and expenditure of public funds for them does not provide for any municipal administrative commission whose authority would extend for the life of revenue bonds. An Indianapolis committee recommended further that new legislation should include authority for cities to lease to private parking concerns the operating rights to the municipal parking areas, in the interest of operating efficiency. This committee was named by Mayor Robert H. Tyndall following a study by the State Highway Commission, showing that the downtown Indianapolis area is now deficient by about 6,000 parking spaces and giving a recommendation that off-street parking be provided.

Baltimore Stadium

Mayor Thomas D'Alessandro, of Baltimore, Md., was authorized by the Board of Estimates to apply to the Federal Works Administration for an advance of $100,000 to finance an engineering survey of a proposed new municipal stadium. The request for the authority was made by the Mayor's Stadium Committee, headed by Glenn L. Martin.

The advance from the Federal Government would be repaid by the city if the $2,500,000 worth of authorized stadium bonds are sold.

The motion for the authority to seek the Federal aid in the name of the city was made by Nathan L. Smith, director of public works, and unanimously voted by the board.

ASCE meeting

(*Continued from page 55*)

eliminate jurisdictional conflicts and confusion and to help avert floods." He pointed out that water is as much a national resource as the country's minerals, and should be regarded as such.

M. W. Torkelson, of the Wisconsin State Planning Board, outlined a plan for diverting 1,500 cfs. from the Wisconsin River into the Fox River for 120 days each year for relieving low-water and improving sanitary and power conditions in the Fox River Valley. Such procedure would be a reversal of the diversion now in effect at Chicago, where Great Lakes waters are diverted into the Mississippi system.

Future developments in the so-called low-grade iron ore deposits in Minnesota were revealed by Elting H. Comstock, former dean of the state school of Mines, and Robert L. Fitzgerald, Duluth Steam Corp. Possibilities include peat-fired reduction plants at or near the mines. An extensive construction program, industrial, railroad, highway and stripping, would be involved.

R. E. Dougherty nominated

The Board of Directors announced that Richard E. Dougherty, vice president, improvements and development, New York Central System, had been named as the society's official nominee for president for the year 1948. Mr. Dougherty has served the society as a director and vice president.

Unions reject raise to help construction

Members of Seattle, Wash., building-trades unions have received a wage increase of 13 cents an hour under a cost-of-living escalator clause but three unions in the Skagit Valley District Council of Carpenters, in Northwest Washington, rejected a similar increase because it "would merely aggravate the cost of living."

The District Council is made up of Bellingham, Mount Vernon and Anacortes locals. All other unions in the building trades accepted the raise but the carpenters divided about 50-50 in their vote, whereas a 55 per cent favorable vote was required for approval.

Don Lindbloom, secretary of the Skagit council, said building in the counties within the council's jurisdiction has slowed and the members believe high costs are responsible. "We hope our action will have its intended effect in the building industry," he said, "and we hope the building-material people will follow our lead and bring down the cost of materials."

The raise would have raised the Skagit scale for carpenters from $1.805 an hour to $1.935. The carpenters did accept 13 cents an hour more from heavy industry contractors where they believe the business can stand the raise without effect on living costs, Lindbloom said.

Under the new Seattle scale, carpenters receive $1.935, brick layers $2.235, electrical workers $2.135, building laborers $1.535, painters $1.935 and plasterers $2.235.

Louisiana road work moves steadily forward

Louisiana is making progress in its nearly $40,000,000 highway construction program with contracts awarded by the highway department totaling $7,436,550 during the first six months of this year, according to Director P. A. Frye. This compares with $2,893,099 awarded in all of 1946.

During June contracts awarded totaled $4,011,794, a pace which Mr. Frye expects to maintain to achieve the $25,000,000 of road improvements in 1947.

The state also has a program for the year of $14,000,000 to $16,000,000 for regular and extraordinary maintenance work. So far this year a total of 124 contracts have been let. Rights-of-way for more than $6,000,000 in new highway projects have been obtained during the first six months and easements for an additional $6,000,000 will be completed in the next two months. Some of these projects include such important jobs as the Calcasieu River bridge at Lake Charles and widening of the Bayou Sara road in Baton Rouge, one of the worst traffic bottlenecks in the state.

Agree on 40-hour week for Boston construction

In an attempt to reduce construction costs and equalize the distribution of construction workers, two contractors' associations in the Boston, Mass., area representing more than 100 leading contractors and subcontractors, have agreed to conduct building operations on a 5-day, 40-hour week basis. The agreement was announced by the Associated General Contractors of Massachusetts and the Building Trades Employers' Association. More than 18,000 workers will be affected of whom an estimated 5,000 who have been working on 6-day projects will have their take-home pay cut by about $22 a week. The average rate in the building trades is about $1.40 an hour.

House group would delay Panama Canal work

A report favoring construction of a sea-level canal at the site of the existing Panama Canal as best from the security standpoint, but asking that all construction for improving the canal be delayed has been made by the House Committee on Merchant Marine and Fisheries.

"A sea-level canal would offer greater security against atomic bombs," the committee reports. However, the group found that a major question has arisen as to what U. S. bases are to be available near the canal. The committee recommends that no construction money be provided for improvements of the waterway until this question of the bases is settled and until completion of the comprehensive study now being made under the direction of Maj. Gen. Joseph C. Mehaffey, Governor of the Canal Zone, as to the best construction plan (*ENR* May 1, vol. p 740).

In discussing the first question, the committee concludes, "Unfortunately, the question of U. S. occupation of defense bases in Panama has become a political issue in that country. Irrespective of the result of the present conflict in interpretation of the existing treaty, there remains the ever-present question of future grants of these bases. Unless the Republic of Panama is willing to grant our nation the right to maintain defense bases in the republic during the coming years, the defense of the canal will be seriously weakened. To pour additional money into the waterway under such circumstances would certainly be unwise and difficult to support. Accordingly, unless and until such time as adequate defense bases are granted, the whole question of future expenditures for expansion of the canal must remain in abeyance."

Connecticut CPA office closes July 25

Bruce S. MacMillian, district construction manager in Connecticut for the Civilian Production Administrator, will close his Hartford office July 25. Orders from Washington terminate the greater part of CPA activities and were issued with the rent control extension bill. The act provides in addition, the ending of curbs on non-housing construction with the exception of recreational and amusement building.

During its existence the Connecticut office of CPA approved 1745 applications for non-housing construction representing a cost of $60,614,017, and denied 573 applications of $18,068,912.

Large construction plans being made by utility companies in Southeast

About $600 million will be spent in the period from 1947 to 1950—Committee is appointed to study power needs of area

Privately-owned utilities in the Southeast have made plans for construction of new plants, installation of new generating units and building of transmission and distribution facilities to cost in excess of $600,000,000 for 1947 through 1950. This gigantic program is the most far-reaching ever undertaken by the electric power companies in the 9-state area from Virginia to Florida.

Plans call for the installation of 51 steam-generating units and three hydro units which will have net continuous capability of 1,942,500 kw., and net peak hour capability of 2,035,500 kw. Of the 51 steam units to be installed, 28 are 40,000 kw. or over, including one 80,000 kw. units, three 100,000 kw. units, and five 135,000 kw. units.

The program of the Southeastern utilities is predicated on the estimated increase in power demands ranging from 20 per cent over 1946 for the next three years, and from 30 to 35 per cent over 1946 for five years hence. Based on present construction and equipment costs, it is estimated that approximately $360,000,000 on transmission and distribution facilities. A great portion of this expenditure will necessitate the raising of new capital, a task in itself of great importance.

Following the annual meeting of the Southeastern Electric Exchange last April in St. Petersburg, Fla., a committee was appointed to study the power requirements of the area and to formulate a program for a giant power pool which would tie-in all the generating and transmission facilities of the member companies in the area, such that any surplus peak or off-peak capacity could be fed into the network to prevent possible power shortage at any point in the network.

This southeastern power pool will bring into force the coordinated and cooperative efforts of the private power utilities to insure against any shortages. It is expected that the present projected construction program through 1950 will only meet anticipated power requirements of industry, as well as commercial, residential and farm customers. This is based on population and industry growth, but should the present industrialization of the South be accelerated at a greater rate a new and more comprehensive power construction program will have to be undertaken.

Many new steam generating plants are now under construction in the Southeast and construction work on others will be undertaken as rapidly as materials and equipment become available. In most instances the installation of new generating units necessitates plant additions or construction of entire new plants.

Congress agrees on funds for Interior Department

The Senate-House Conference Committee has approved $194,500,000 for the Department of Interior for the present fiscal year. Passage of the compromise bill is expected this week by both houses. The bill as reported out provides $93,367,038 for the Bureau of Reclamation, which is considerably more than the House provided (*ENR* May 1, vol. p. 725) but much less than the Senate favored (*ENR* June 19, vol. p. 971). If Congress completes action this week, a detailed report will be published next week.

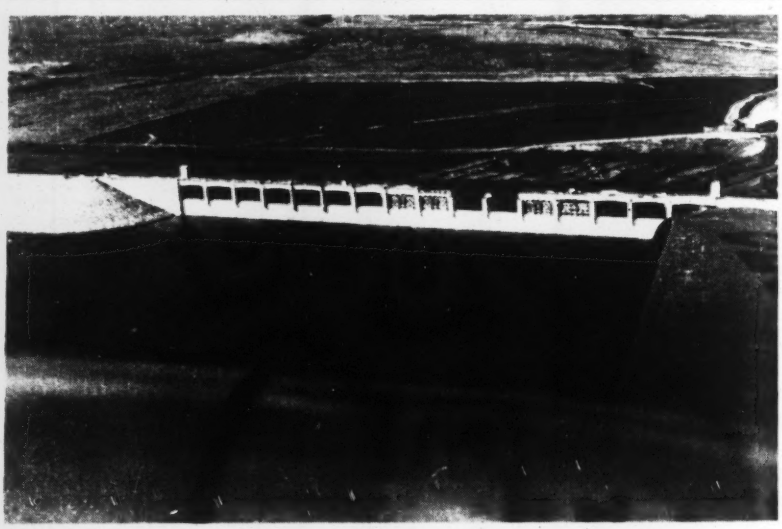
House votes $35,500,000 for reuse housing work

A bill (H. R. 3756) supplying $35,500,000 for the National Housing Administrator for the veterans' reuse housing program has been passed by the House and passage by the Senate is expected. The money will salvage about 8,000 war housing units. The work is part of a program calling for use of 200,000 units for which over $1,3,000,000 has already been provided. Eventually $3,200 per unit will have been spent for housing that must be removed within a few years.

No action this session on St. Lawrence Seaway

Legislation to authorize the half-billion-dollar St. Lawrence seaway and power project and make it pay for itself through tolls was approved July 15 by a Senate foreign relations subcommittee, but Senator Arthur H. Vandenberg, chairman of the Senate Foreign Relations Committee, says there is no chance for Senate action on the proposal in this session of Congress. The measure is being considered by the House Public Works Committee.

For details of the current estimates of the cost of the seaway and power project see p. 84 of this issue.



***Nearly Ready**—John Martin Dam, a 7,000,000 cu.yd. structure 80 mi. below Pueblo, Colo. on the Arkansas River, is nearing completion as contractors work on final details of a 1,600-ft. long bridge structure and the installation of 16 steel Tainter gates. Built for the Corps of Engineers as a flood-control structure, work on the dam was largely completed in 1943, when it was halted because of wartime materials shortages. The Morrison-Knudsen Co., of Boise, Idaho, is contractor on the work.*

950 mgd. water plant recommended for Chicago

A single 950 mgd. water treatment plant that will cost about $61.7 million and serve the central and north districts of Chicago has been recommended to the city council in a recently released report prepared by the firms of Greeley & Hansen and Alvord, Burdick & Howson, consulting engineers.

Separate plans located on each intake tunnel system were considered but the economic study revealed that a single plant located east of Lake Shore Drive and north of Navy Pier would be preferable. Containing 55 acres, this site is adjacent to a district zoned for industry and commerce and is served readily with rail facilities.

The proposed plant will take raw water from the Dever and Harrison cribs located in Lake Michigan but during construction a shore intake will be utilized.

Filtered water will be supplied to the central district tunnel system through a short connection to the shore shaft at Chicago Avenue, estimated to cost $2,972,000. The north district system will be supplied through a new tunnel connecting the proposed filtration plant and the Wilson Avenue tunnel system. This tunnel will cost about $8,022,000.

The plans and specifications for the tunnel systems have been approved by the Illinois Department of Public Health.

Science foundation bill passed by House

July 16 the House passed with some amendments a bill (S. 526) establishing a foundation for research in pure science. The Senate had passed a similar bill May 20, which would indicate that some version of the measure is pretty sure to become law before Congress recesses.

Work of the foundation would be centered in a board of 24 scientists. These men would choose a director for the foundation. A program involving about $20,000,000 the first year is anticipated. This money would include the actual research and the training or education of a limited number of young scientists showing outstanding ability. About 25 percent of the money spent would be distributed to state colleges and universities. The foundation would work closely with existing federal research groups and would use the laboratories of existing agencies, rather than establish independent facilities.

Sowers to direct Ohio public works

George B. Sowers, 54, former city engineer and chairman of the port and harbor commission of Cleveland, has been appointed Ohio Director of Public Works by Gov. Thomas J. Herbert, effective Aug. 1. He succeeds Frank L. Raschig, Cincinnati, who held the post since 1940. Raschig will take over the newly-created position of chief consulting engineer in the department.

Sowers was city engineer in Cleveland from 1914 to 1932, directing the construction of the Cleveland stadium and the $5,500,000 Cuyahoga River straightening, after which he was engaged in private practice as a consulting engineer. During the war he served three years as a lieutenant colonel in the transportation phase of the Military Government Section, and saw service in the African, Italian, and Korean campaigns in 30 months overseas. He is a graduate of the Case Institute of Technology, 1913.

Claim highway progress threatened by auto taxes

More than 400 national and state organizations of highway users, representing a combined membership running into the millions, have petitioned Congress to end all special federal automotive taxation as an unjust burden on the highway user.

The signatory groups included major national associations as well as state and regional organizations. They represented automobile clubs, farm groups, bakers, bottlers, automotive and other manufacturers, letter carriers and numerous other organizations.

Copies of the petition, presented to Congress by the National Highway Users Conference at the request of the signers, were sent to the House Ways and Means Committee and the Senate Finance Committee.

The Federal taxes include special levies on new motor vehicles and trailers, gasoline and oil, tires and tubes, and parts and accessories. They brought in revenue of more than $800,000,000 in 1946, but revenues are running at an even greater rate this year.

The levy on new cars, adds a minimum of about $70 to the cost of even a low-priced automobile.

Pollution control bill passed by Senate

A pollution-abatement bill (S. 418) incorporating many of the changes suggested by the Federal Works Agency late in May (*ENR* May 22, vol. p. 847) has been passed by the Senate.

General supervision of the program is centered in the Surgeon General's office and the Federal Security Agency. However, assistance on detailed planning and construction would be supervised by the FWA.

The revised bill would permit loans totalling $100,000,000 annually to states, local public works groups and industry for the construction of treatment facilities. These loans would be made through the FWA, they would be restricted to ⅓ the estimated construction cost of a project, and an interest rate of two percent would be provided.

Advances to a total amount of $12,000,000 yearly to public works bodies only for detailed planning of control facilities would also be possible. These advances, which are not grants, would need to be repaid without interest when construction of a given project is begun.

The bill also provides appropriations to the extent of $5,000,000 yearly for the Surgeon General's office to assist states and local groups in surveying and evaluating pollution abatement needs.

Only interstate waters are covered in the bill. If a river does not flow into another state, no aid would be given in cleaning up that stream, since such work is looked upon as strictly a regional problem. Federal enforcement of abatement orders would be possible only after the effort of a state to get action has failed and then only with that state's consent.

Pledge survey money for Oklahoma turnpike

Representatives of five cities interested in the construction of the $30,000,000 Tulsa-Oklahoma City turnpike have pledged the early subscription of a $50,000 fund to defray cost of preliminary traffic and engineering surveys for the project.

To carry out the preliminary work a four-member authority is expected to be named early in August.

Governor Roy J. Turner said that the work would start as soon as the authority is named and he added that an engineering firm was available for this work.

ENGINEERING SCHOOL NEWS

T. Keith Glennan chosen head of Case Institute of Technology—Research at North Carolina—Faculty changes

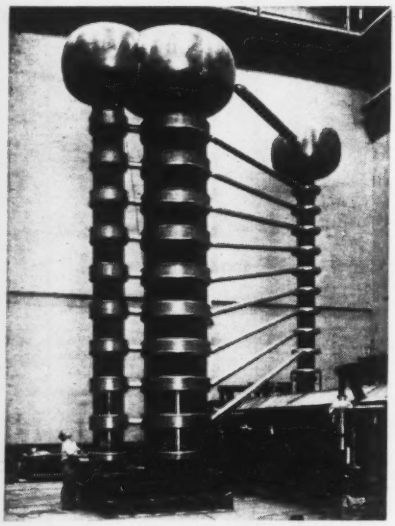
The selection of T. Keith Glennan, 41, now an executive of Ansco Division of General Aniline & Film Corp., Binghamton, N. Y., and wartime director of the U. S. Navy Underwater Sound Laboratory, as president of Case Institute of Technology, has been announced. He will be the first business executive to head the Cleveland engineering school, which has had only three presidents since its establishment 67 years ago as Case School of Applied Science. He succeeds Dr. William E. Wickenden who will retire on September 1, after 18 years of service.

Mr. Glennan grew up in Eau Claire, Wis., and entered the state normal school there in 1922, intending to teach mathematics. After two years, he transferred to the Sheffield Scientific School of Yale University where he was graduated in 1927, "cum laude." with a degree in electrical engineering.

He started his business career in sound equipment work which carried him to 30 states and ten foreign countries between 1927 and 1932 when "talkies" were getting started, and spent the next nine years in movie studio management with Paramount Pictures and others in New York and Hollywood. Since January 1946, as Ansco's manager of general administration, he has directed all of its engineering, production planning, personnel, industrial and public relations, purchasing, general administration and office services. He received the Medal for Merit for his work from 1942 to 1945 at the U. S. Navy Underwater Sound Laboratory which was operated by Columbia University at New London, Conn., for the Office of Scientific Research and Development, headed by Dr. Vannevar Bush.

In the expanding program of the engineering school at the North Carolina State College, research is taking a prominent part. The availability of the staff and physical facilities for assistance in research and development is considered one of the vital parts of this program.

Orginially established in 1923 as the engineering experiment station, the present department of engineering research maintains laboratories and a full-time staff devoted exclusively to research. It operates separately from the other units of the engineering school but with full access to those departments' facilities, laboratories, and personnel. Civil engineering embraces the division of structural, sanitary, transportation, and construction engineering, and each branch is supplied with special laboratory facilities. Research-minded men in each division are prominent in the departmental staff.



X-Ray Machine Tests Concrete—

One and a half million-volt X-rays are used in an extensive program under way at the National Bureau of Standards to determine the effectiveness of concrete as a protective barrier. Six-inch thick test slabs are used to vary the barrier up to a total of 5 ft. in thickness, and sandwiches of lead and concrete may also be used.

Two appointments to the faculty of the Gonzaga University's school of engineering at Spokane, Wash., have been announced by Dean James G. McGivern. They are T. R. Hance, formerly an instructor at Kansas State College and with the Ryan Aeronautical Co., where he was engaged in work on a high speed jet propelled fighter for the Navy, and Walter T. Woodward, formerly of the Bureau of Reclamation, Wyoming Highway Department and the U. S. Indian Service, specializing in water supply studies. Both are graduates of the University of Wyoming.

The first lecture by a woman civil engineer to be given at the University of Illinois was presented recently by Dr. Ruth Terzaghi, wife of Dr. Karl Terzaghi, consulting engineer, Winchester, Mass., upon the subject, "The Chemical and Physical Weaknesses of Concrete."

A survey conducted by the Wartime Bureau of Technical Personnel on behalf of Canada's Department of Labor shows that the Canadian universities in the five years 1947-1951 expect to graduate 12,885 students in engineering, as follows: 1947—1,111; 1948—1,800; 1949—3,487; 1950—3,730; and in 1951—2,757.

The present estimate of the demand for engineers over this 5-year period is: Civil, 2,200; mechanical, 2,100; electrical, 1,750; mining, 1,300; chemical, 1,100; metallurgical, 300; various, 700.

By next fall Rensselaer Polytechnic Institute, Troy, N. Y., will be the country's largest privately endowed school of science and engineering, exclusive of graduate and evening students, President Livingston W. Houston reported June 14 at the annual meeting of the Rensselaer Alumni Association. Enrollment in September will exceed 4,500, three times the prewar level.

Prof. Frank Kerekes has been appointed assistant dean of the division of engineering and J. D. Ryder as assistant director of the Iowa State College Engineering Experimental Station. Professor Kerekes has been a member of the department of civil engineering since 1920. Chairman of the Ames City Plan Commission for seven years, he has received the John Dunlap award of the Iowa Engineering Society for his work on a uniform state building code.

McGill University will carry on second year engineering training next session on both the campus and at Dawson College, St. Johns, it is disclosed by F. Cyril James, principal and vice-chancellor of the university.

Previously it had been announced that all second year students in engineering would remain at Dawson College. There are 600 to be provided for. A canvas has disclosed that 400 of these, now at Dawson College, have found their own lodgings in Montreal, and it has been found possible for the engineering faculty to arrange classroom and laboratory accommodation for this group on the campus. Another 200 will remain at Dawson.

The removal of 400 men from Dawson College to Montreal will provide additional space at Dawson to take care of the large influx expected in first year B.S. and first year engineering.

(*Continued on page* 114)

OBITUARY

Rupert Andrew Anderegg, 53, professor of civil engineering at the University of Cincinnati, and authority on flood control, died July 18.

Professor Anderegg supervised flood, power, navigation, and irrigation studies in the Ohio-Kentucky area for the Federal Government in 1920. Working through the Cincinnati district engineer's office, he was in charge of studies and reports on the Miami River, made preliminary reports on the Kentucky River, and supervised preliminary studies on the Scioto and Licking Rivers in the nineteen thirties. He worked with the Coast and Geodetic Survey project on various control surveys in Ohio in 1919.

An alumnus of the University of Cincinnati College of Engineering, Professor Anderegg had been a member of the Cincinnati faculty since 1921, when he was appointed an instructor in civil engineering. He was promoted to assistant professor in 1923, to associate professor in 1930 and to professor in 1941. During the first World War he served in France with the Twenty-first Engineer Corps. During the recent war he was on a leave of absence from the university to serve with the Cincinnati Ordnance District.

William Irvin Boyd, 75, civil engineer and one time assistant surveyor of the District of Columbia, died July 10 in Chestnut Hill, Pa. He was graduated from Lehigh University in 1893 with a civil engineering degree.

W. H. Terrell, 79, of Clyde, N.C., town engineer for Clyde, Canton, Waynesville and Hazelwood, N.C., died July 11. He had been connected with a number of engineering projects, including the building of the Maderia railroad in South America, and work for the Illinois Glass Co. at Alton, Ill., Cliffside Mills at Cliffside, N.C., Armour and Co. at Chicago, Ill., the White Oak Mills at Greensboro, N.C., and excavation for the Battery Park Hotel at Asheville, N.C., and for the Duke Power Co. at several places. He also had served the Southern and Seaboard Railroads and as location engineer for the Champion Paper and Fibre Co.

Michael Del Balso, 69, president of the Del Balso Construction Corp., New York, died July 12. The total value of the structures built and work done by Mr. Del Balso's company has been estimated at more than $200,000,000. They include parts of the East River Drive and of the Independent and BMT Subways, and Riverside Drive; in addition to ammunition depots in Nebraska and Oklahoma, storm sewers in Washington, D.C., and a plant for the Carnegie Steel Corp. in West Virginia.

Harry Leonard Wrenn, 69, who until his retirement was associated with the bridge maintenance department of the North Carolina Highway Department, died July 10 at his home at Raleigh, N.C.

Frederick DeSales Willson, 86, chief hydrographer in Panama for the government during the construction of the Panama Canal, died in Washington, D.C., July 8. He was engaged in work on the Panama Canal during the years from 1904 to 1918.

John Hugh Clemmer, 59, Akron, Ohio, vice-president of the Clemmer Construction Co., died July 3. He was graduated from Case School of Applied Science, Cleveland. He was twice named chairman of the state board of building standards and also was a former Civil Works Administration supervisor.

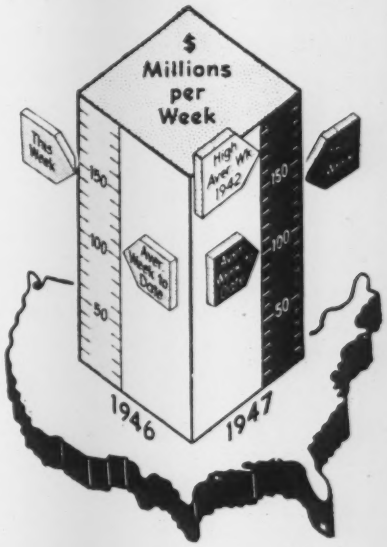
Howard A. Perkins, 40, of Wilmington, Del., president of the Wilmington Construction Co., was killed July 10 when the company's amphibian plane crashed while attempting to make an emergency landing in Philadelphia, Pa. He was son-in-law of Lammot duPont, chairman of the board of directors of the duPont Co. Mr. Perkins had taken part in the building of more than 2,000 homes in the Wilmington area and in Chester, Pa.

Roland W. LeFavour, 58, of Malden, Mass., assistant professor of engineering at Tufts College, died July 15 at Malden.

Norville J. Alleman, 43, special research professor of engineering materials, University of Illinois, died July 13. He was graduated from Illinois in 1925 and obtained his master's degree in 1927. He joined the staff of the college of engineering in 1927 and advanced to the rank of research professor. For a number of years he was associated with Prof. H. F. Moore on projects dealing with the fatigue of metals, lead sheathing for cables, and railroad rails.

Harold Everhard, 42, an employe of the Ohio State Highway Testing Laboratory, died July 11 in Dayton. He was a graduate of Ohio State University, where he received his master's degree in 1928.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of July 24, 1947	Cumulative 1947 (30 wks)	Cumulative 1946 (30 wks)
Federal	$10,118	$399,897	$473,515
State & Mun.	49,179	967,832	779,792
Total Public	$59,297	$1,367,729	$1,253,307
Total Private	75,468	1,729,540	1,915,473
U. S. Total	**$134,765**	**$3,097,269**	**$3,168,780**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1947 (30 wks)	Cumulative 1946 (30 wks)
Waterworks	$2,375	$65,074	$56,367
Sewerage	2,434	75,048	57,770
Bridges	4,988	93,622	75,951
Highways	27,190	464,612	449,661
Earthwork, Waterways	2,997	189,128	270,581
Buildings, Public	9,636	312,994	227,376
Industrial	11,464	436,419	596,895
Commercial	60,146	1,031,323	1,199,919
Unclassified	13,535	429,049	234,260

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1947 (30 wks)	Cumulative 1946 (30 wks)
NON-FEDERAL	$64,824	$979,277
Corporate Securities	27,264	300,968
State and Municipal	37,560	453,309
Fed. Aid Highway		225,000
FEDERAL		1,498,168
Total Capital	**$64,824**	**$2,477,445**

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	July '47	406.52	195.41
Building Cost	July '47	304.87	164.80
Volume	June '47	276	121

EDITORIALS

VOLUME 139 NUMBER 4

July 24, 1947

Costs Not Coming Down

ENGINEERS AND CONTRACTORS can make an important contribution to stabilization of the national economy by counteracting the widespread impression that construction costs are out of line with other costs and are sure to decline sharply in the not too distant future. Construction costs today are somewhat higher than they should be due to continuing uncertainties as to the availability of construction materials and inefficiencies of the labor force, but any gains that may result from elimination of these factors probably will be offset by further increases in prices of materials and labor rates. The factors pointing to this conclusion are clearly set forth in the statement by Harry A. Ward of the Turner Construction Co. on p. 88 of this issue. Like views were expressed by Forrest W. Parrott, president of the Associated General Contractors of America, last week at the convention of the American Society of Civil Engineers in Duluth. More statements like these from informed engineers and contractors would go a long way toward offsetting the pronouncements of some of the financial advisers whose predictions of sharp declines in construction costs have resulted in curtailment of work that should be under way. As Mr. Ward points out, the only thing that can bring construction costs down would be a serious business depression, which everyone wants to avoid. Yet holding back on plant expansion that is needed to meet growing demands for consumer goods is one way to help bring on a depression.

Minimum-Shelter Housing

IN A PRACTICAL DEMONSTRATION of how low-cost housing can be furnished veterans who are willing to contribute a limited amount of their own labor, a civic-minded group of business men in Painesville, Ohio, built a 50-house model project. As described elsewhere in this issue, the four-room houses with garage attached subsequently were sold to veterans for about $6,000; this combined with a small cash out-lay for a few additional materials and some handicraft effort by the owner to add the finishing touches provides a liveable house. Among the chief virtues of this plan is a minimum initial cost of high-type construction due largely to cooperative operations by the contractor, architect, realtor and financing company. Then, too, pride of ownership is increased along with a further reduction in cost by the veteran-owner contributing to the physical construction of his house. The success of the low-cost, joint venture housing project at Painesville suggests the desirability of similar operations elsewhere.

Median Barriers

CALIFORNIA'S EXPERIMENT with median barriers on steep grades, reported in the July 10 issue, vol. p. 36, is deserving of special attention. Experiments made some years ago on Michigan highways may have been the inspiration for the California proposal, but whatever the original source of the idea, valuable safeguards may result from further developments along this line. Profiting by experience already gained with the inclined-face barrier between opposing lines of traffic, engineers of the California Division of Highways have developed a design for use along the outer edge of pavements where there is not room for a shoulder. It may also have a possible use on viaducts. This in turn may lead to some entirely new conceptions as to what a bridge curb and railing should be.

Earthquakes and Building Codes

SINCE THE WAR ENDED attention has again focused on deficiencies of San Francisco's building code, long overdue for revision, particularly as to provision for the horizontal forces set up by earthquakes. Part of the delay, even before the war, was difference of opinion among the experts. What allowances should be made? How and where should the additional strength or rigidity be provided? So many different theories were advanced that city authorities, apparently despairing of any meeting of minds, arbitrarily wrote into a revised code requirements that some designers consider too severe (*ENR* June 26, vol. p. 992). Protests, chiefly from those who specialize in the design of tall buildings, point out that the new provisions impose an unduly heavy burden on structures more than twelve or fourteen stories high. Specifically they object to putting about half the total seismic allowance into the steel frame. This is excessive, they claim, as compared to the one percent that prominent designers have used heretofore. Also, the objectors feel, the seismic factors in the revised

code are higher than necessary for top floors. Thinking back to the 1906 disaster in San Francisco, it appears that this city more than any other in the United States should recognize the importance of adequate safeguards against earthquake damage. Even though some time may be required to try out and settle upon the most satisfactory seismic provisions in a new code, other cities should await San Francisco's final decision with much interest. Earthquakes have a disturbing habit of occasionally shaking up localities previously thought not to be in "an earthquake zone."

More About the St. Lawrence

NEW FACTS relating to the St. Lawrence waterway were brought to light at recent hearings before a Senate subcommittee. They call for thoughtful analysis by all who seek to form logical conclusions concerning that controversial undertaking.

Of first interest to civil engineers is a sharp upward revision of the cost estimates, details of which are given on p. 84 of this issue. The Army Engineers have increased their estimate of work yet to be done from the 1941 figure of $409,340,900 to $674,707,000, using the *ENR* Construction Cost Index as the basis for the upward revision. However, as they did not apply similar factors to estimates made by Canadian engineers in 1941 as to the cost of the work to be done by Canada below the International Rapids, a more accurate measure of the total work yet to be undertaken would be $717,336,000.

The effect of any such large increase in cost upon the economics of the waterway is obvious. Part of the added cost, it is true, will be chargeable to the proposed power developments, but there still will be a much greater charge against navigation than was included in the 1941 estimates.

If the economic justification for the waterway was questionable in 1941, it would be even more so now unless new factors have entered into the computations since then. Such factors have appeared, according to W. A. Harriman, Secretary of Commerce, who incidentally, is confident that the waterway will be a paying proposition under the tolls called for in the legislation now before Congress. Secretary Harriman believes that this country should make early provision for the movement of iron ore into the Great Lakes from sources outside this country in view of the rapid exhaustion of the high-grade ores in Minnesota. A potential source of such ore is Labrador, which would make the St. Lawrence River a natural route to our inland steel-producing areas. Mr. Harriman also foresees the possibility of large movements of petroleum from the Middle-East directly to our lake ports through the ship canal.

These are possibilities that warrant consideration, but it appears to the editors of this journal that the waterway always must take a secondary place in planning for the St. Lawrence River. The great amount of firm power that can be developed between Lake Ontario and Montreal is the chief consideration. And when dams are built to develop that power, common sense would appear to dictate that the present antiquated ship canal should be replaced by a modern one. The day when St. Lawrence power will be needed appears to be approaching so rapidly as to indicate that the start of work on the project should not be too long delayed.

Effective Collective Action

CALIFORNIA'S amplified registration law that was passed recently (*ENR* July 17, vol. p. 91) was rewritten during the process of legislative action until it conformed to ideas of California's civil engineers as to what would best protect the professional standing and prestige of engineers as built up in the many years during which only civil engineers have been registered in that state. This desire to protect and further professional standing should be commended as should also the effective way in which the civil engineers brought their idea to the attention of the legislators. Their endeavor bore weight because it represented the unified efforts of all civil engineering organizations in the state without dissension.

Similar cooperation on a national scale resulted in success in getting Congress to write into the Taft-Hartley Act provisions concerning professional men favored by engineers. Because of the large number of engineering organizations, such close cooperation was difficult to obtain in the past. These examples of its effectiveness should simplify the task of obtaining agreement on future legislation programs.

ENGINEERING NEWS-RECORD
Copyright, 1947, by McGraw-Hill Publishing Company, Inc.
WALDO G. BOWMAN, *Editor*, EDWARD J. CLEARY, *Executive Editor*
New York: V. T. BOUGHTON, R. K. TOMLIN, H. W. HUNT, E. E. HALMOS JR., T. D. MacGREGOR, JOHN C. BUMSTEAD and F. S. MERRITT
Chicago: V. B. SMITH, *Cleveland:* J. R. CARR, *Washington:* A. N. CARTER, *San Francisco:* N. A. BOWERS, L. L. WISE
EDITORIAL OFFICES: 330 WEST FORTY-SECOND STREET, NEW YORK, N. Y.

Fig. 1. Trestles for whirler cranes rise with concrete for Bluestone Dam on New River at Hinton, W. Va. Note relocated highway, State Route 20, above the reservoir level.

Whirler Cranes Build Bluestone Dam

***Contents in Brief**—Bluestone Dam, delayed by the war, is now being completed but with a minimum of steel for construction uses. Unreinforced concrete columns that become part of the dam carry whirler cranes at several levels to place concrete in the high structure planned for flood control and power.*

WIDE-GAGE whirler cranes are being used to place all of the 950,000 cu. yd. of concrete in the 200 ft. height from foundation rock to the top of Bluestone Dam on the New River near Hinton, W. Va. Unreinforced concrete piers 8 ft. in diameter are poured in 33 ft. lifts to support a temporary trestle and cranes up to 30-ton capacity, sometimes with high gantries, are "jumped" to a higher elevation in a matter of hours.

Bluestone Dam is being built for the Ohio River Division, Huntington District, of the Corps of Engineers U. S. Army as a concrete gravity structure for flood control and with provisions for possible future development of power.

The New River flows through mountainous country that has a high runoff, which has produced ruinous floods on the New River and has contributed to serious floods along the Kanawha River, an important tributary of the Ohio. The drainage area of 4,565 sq. mi. above the Bluestone Dam has an average rainfall of 40 in. per year.

Three dams up stream

Above the site the Appalachian Electric Power Co. has three hydroplants: Buck and Ryllesby dams completed in 1912 and Claytor Dam, completed in 1941, *ENR* March 13, 1941, vol. p. 392.

Bluestone Dam will have a head of 150 ft. and will store 622,800 ac.-ft. of water at maximum flood crest, which is 1,520 ft. above sea level.

Twenty-one 30-ft. wide by 31-ft. high gates, above the spillway crest at El. 1490, with sixteen 5-ft. 8-in. by 10-ft. sluice gates at El. 1389 will pass floods of 430,000 cfs., nearly twice the maximum recorded flow on the river. A 23-ft. deep stilling pool formed by a concrete weir 360 ft. downstream from the dam axis will dissipate the energy from the overflow. Diffusers in the sluice outlets are expected to produce a spray that will fall harmlessly into the stilling pool.

Plans are availabble for producing power at the dam under an effective head of 100 to 120 ft. Intakes and trash racks are being built as part of the current work but none of the power structures is being put in at this time. Ultimately six 19-ft. dia. penstocks to supply six 30,000-kw. units can be installed to produce over 415,000,000 kwh. annually.

There are 20 spillway monoliths, 18 of which are 38 ft. and two are

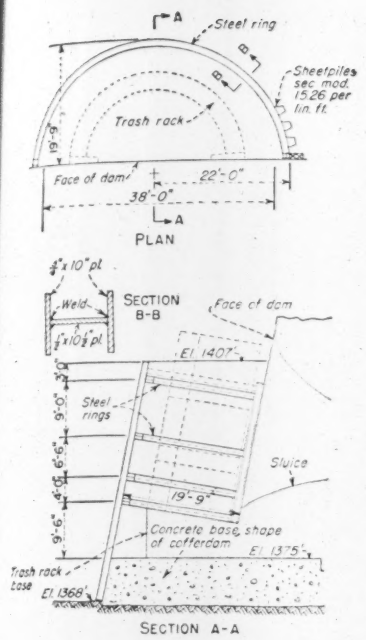


Fig. 2. Closure of diversion blocks will be effected by setting sheetpiles around a frame of circular beams, after which the concrete for the intake sluices (shown shaded) will be placed.

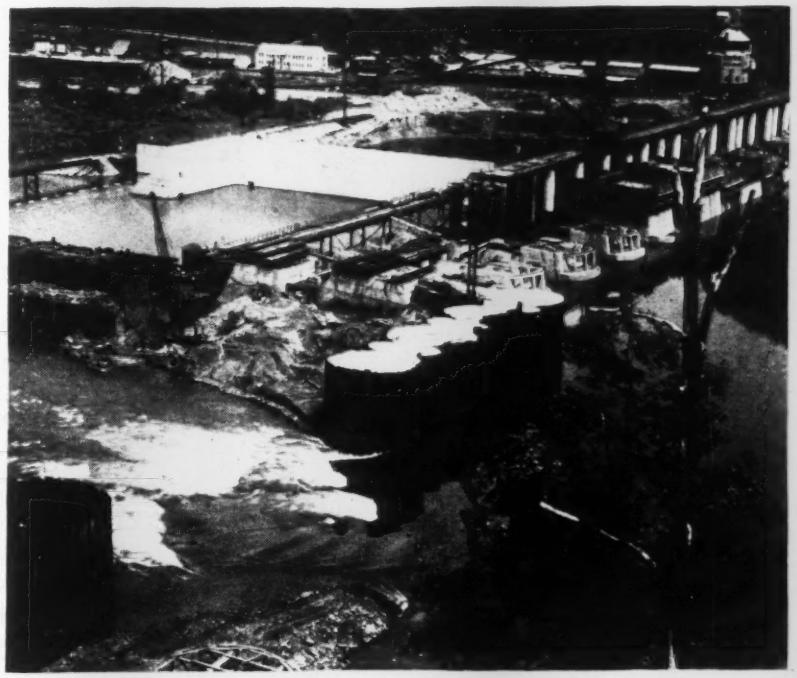


Fig. 3. Cofferdam being placed for the second stage of construction. Concrete was at about this stage while the job was shutdown during the war years. Opening left in the dam to carry the flow after completion of this cofferdam can be seen beyond the right end of the row of cells.

45 ft. long parallel to the axis of dam. The six intake monoliths are each 55 ft. long. Non-overflow sections at each end and a spillway gate assembly bay near the center of the dam make up the rest of the 2,061 ft. length of concrete between high rock bluffs along both sides of the river.

Only a shallow depth of undesirable material overlies moderately good sandstone at the dam site. Extensive grouting is required however.

Plans for Bluestone Dam were completed by the Corps of Engineers in 1936 but construction was blocked by court action of a utility company that owned the site and had planned a power dam at a lower head. Court rulings finally cleared the way for government construction and operation and the contractor, the Dravo Corporation of Pittsburgh, started field work on the dam in January 1942. Work was ordered stopped two years later when it appeared that the dam could not be completed in time to be of value for flood control or power for the duration of World War II. However, all work necessary within the first stage cofferdam was completed prior to the shutdown.

Construction was resumed in 1946 under a modification of the original contract. Since the delay made little difference in the methods used in construction, the project will be described as a continuing job.

Steel sheetpile cofferdams

Diversion of the broad and shallow New River for the first stage of construction was done by cofferdaming a little more than half the stream and bringing all the concrete within it to a little above normal low water. Four 38-ft. wide monoliths in the first cofferdam were left at El. 1375 to carry the flow of the river while the cofferdam was shifted to enclose the rest of the river bed.

Cellular sheetpile cofferdams 30 ft. dia., were built to El. 1391 for the first stage and 40-ft. dia. cells built to El. 1405 were used for the second stage on the upstream and riverside arms.

Cells were filled from miscellaneous excavation for the dam and then were capped with concrete to prevent wash from overflow in case of overtopping. On the downstream side a rodded "Ohio River box" type of cofferdam was built with timbers for the first cofferdam. The downstream cofferdam for second stage was built with parallel sheetpile walls tied by three rods in each eighth pile for the 14 to 16 ft. height. Sheetpiles were used primarily because they were available, and lumber was not.

Closure of the 38-ft. wide slots left in the dam for diversion of the river during construction is to be accomplished by means of a semi-circular steel cofferdam, as shown in Fig. 2. Concrete frames for the trash racks also will be built within these cofferdams.

The contractor's plant for construction is laid out along the right bank of the river where a flood plain gave some room. The opposite bank is quite steep with no natural room for any plant installation.

Road access to the plant site is over

TABLE I: CAPACITY 30 IN. BELT.

BELT SPEED 250 FT. PER MIN. ON LEVEL, 350 FT. PER MIN. ON 13 DEG. SLOPE.

Actual test under job conditions

Material	Tons per hour
Limestone sand	525
River sand	450
¼–¾ in. crushed stone	488
¾–1½ in. crushed stone	375
1½–3 in. crushed stone	338
3–6 in. crushed stone	300

TABLE II—BASIC CONCRETE MIXES USED AT BLUESTONE DAM

Air entraining mixes shown in bold face type

	Mass concrete		Face concrete		Heavily reinforced	
Cement — in sacks per cu. yd.	3.5	**3.0**	4.5	**4.5**	5.5	5.5
Air entraining agent, per cu. yd.		**125 cc.**		**187 cc.**		230 cc.
Water/cement ratio — by volume	0.933	**0.912**	0.733	**0.676**	0.760	0.768
by weight	0.620	**0.606**	0.488	**0.446**	0.505	0.511
Ratio of fine to total aggregate	32%	**28%**	32%	**30%**	38%	38%
Ratio of manufactured to natural sand	25:75	**75:25**	25:75	**75:25**	40:60	75:25
	Weight per cubic yard of concrete					
Cement	329 lb.	**282 lb.**	423 lb.	**423 lb.**	517 lb.	517 lb.
Manufactured sand	300	**779**	294	**798**	522	931
Natural sand	871	**251**	851	**257**	757	300
6 in.–3 in.	791	**881**	773	**769**	.....	.....
3 in.–1½ in.	689	**722**	674	**670**	.....	.....
1½ in.–¾ in.	587	**588**	573	**571**	1,277	1,215
¾ in.–¼ in.	485	**481**	474	**471**	852	810
Water	204	**171**	206	**189**	261	264
Total	4,265 lb.	**4,155 lb.**	4,268 lb.	**4,148**	4,186 lb.	4,037
Average compressive strength, 28 days	4,270 psi.	3,030 psi.	5,480 psi.	4,565 psi.		

Specific gravity of natural sand 2.63; manufactured sand and coarse aggregate 2.72.
Only 1 percent of natural sand passes the 100-mesh screen, 12 percent of manufactured sand.

a 9-ft. wide paved road that still serves. Practically all materials come to the job over a 1¼-mile railroad connection built by the contractor to the Chesapeake & Ohio Ry. at Hinton. This railroad required a 1,115-ft. crossing of the Greenbrier River, the main members of which were 36-in. 350-lb. beams 46 ft. long that were set on sheetpile encased piers supported on hardwood piles.

All aggregates come to the job by rail in hopper-bottom cars and are unloaded by dumping over a series of pits, one for each of four sizes of stone and two kinds of sand. The rail yard is laid out on a one-percent grade with yard space above the dumping pits for 42 cars of aggregates arranged so that they can move over the pits by gravity. Material is picked up from the individual pits by a 3-cu. yd. clamshell bucket on a 20-ft. track-circle whirler and deposited in a series of timber bins on pile supports over a belt conveyor. The six bins have a live storage capacity of 12,000 tons, proportioned to make about 6,500 cu. yd. of mass concrete. While this storage is relatively small for a plant with a potential production of 4,300 cu. yd. per day, most of the aggregates move only 25 miles and on only one railroad, so delivery in a few hours can be depended on.

Aggregates are reclaimed through gates feeding on to a 30-in. wide 250-fpm. conveyor belt that has actual capacities as shown in Table I. The belt deliveries to a manually operated turnhead at the top of a six-compartment nominal 750-ton capacity bin. Actual production possible from aggregates stored in the bin is 340 cu. yd. or about two hours run.

Cement moved by air

Bulk cement also comes to the job by rail in covered hopper-bottom cars and is unloaded through air-activated tanks. Cement is blown a distance of 500 ft. horizontally and 100 ft. vertically to an 800-bbl. compartment in the center of the mixer plant, or to a storage silo. Originally, a 4-in. line was installed for this service but it plugged frequently at 55 psi. while pressures of 75 psi. split canvas connections. A 6-in. line was installed and it works very satisfactorily at the lower pressure, moving about 134 bbl. of cement per hr. gross time. About 800 cfm. of air is used or 213 cu. ft. per barrel of cement moved.

In the mixer plant, push-button controls activate air-cylinders that open gates to start filling the batchers, which weigh aggregates, cement and water automatically. Air-cylinders dump the batch into any one of three 3-cu. yd. front-charging tilting mixers. Mixing for 2 min. is required from the time all materials are in the drum. A 3-min. cycle is maintained so that capacity is 60 cu. yd. per mixer per hour or 180 cu. yd. of concrete per hour from the plant.

Three mixes of concrete used in Bluestone Dam are shown in Table II. Cement is a modified low-heat type with 0.6 to 0.8 percent of a dispersing admixture ground into the cement.

Lack of fines troublesome

All coarse aggregate and part of the fine aggregate is crushed stone. Until quite recently, only 25 per-

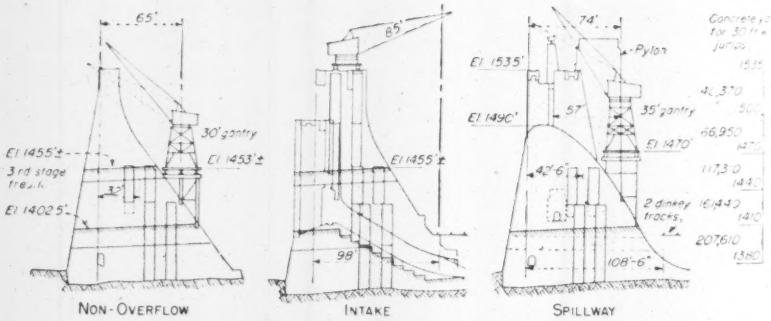


Fig. 4. Schematic drawing showing the location of whirlers to reach all the 1,100,000 cu.yd. of concrete in the dam.

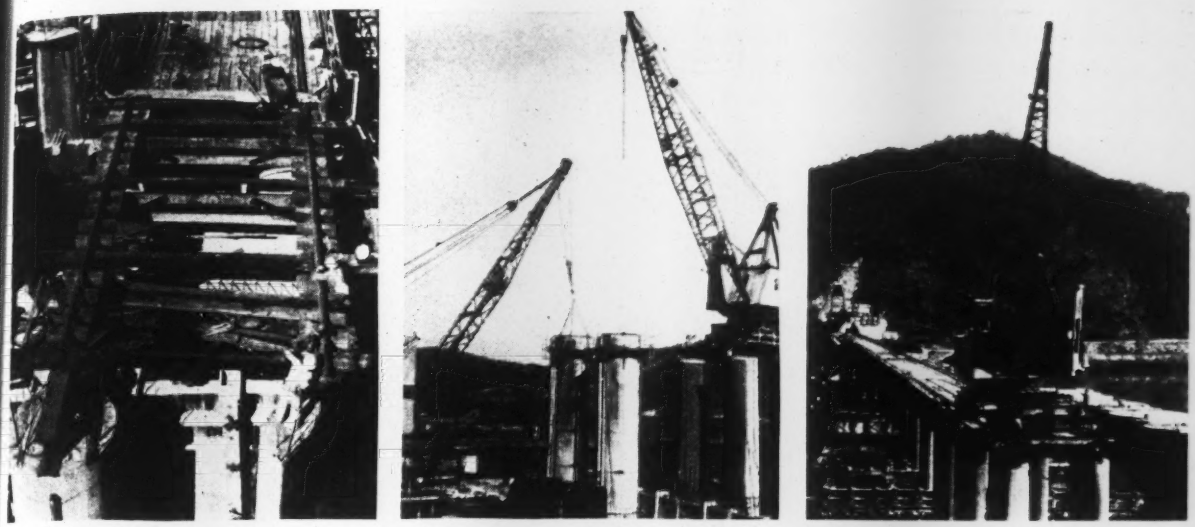


Fig. 5. Whirlers are moved upward in steps. Left: Decking over sectional rails is taken off in panels—as it can be for concreting below track—then tracks are moved as a unit and beams handled separately. Center: Steel forms 8 ft. dia. and 33 ft. high are set and 30 ft. of concrete placed in them. Right: Main body of whirler, with hoist, is raised in one p[illegible]e.

cent of the fine aggregate consisted of manufactured sand. This percentage was determined by the fact that the only economical source of this material to the contractor was from the normal crushing operations in the production of the coarse aggregate. Natural sand available has only 1 percent passing the 100 mesh sieve, while 12 percent of the manufactured sand passes the 100 mesh. A blend of 75 percent natural sand and 25 percent manufactured sand had only 4 percent passing the 100 mesh screen, which just met the minimum specifications. While very high compressive strengths were consistently obtained, the concrete bled to some extent while air and water pockets tended to mar the sloping downstream surfaces.

Studies of sand and admixtures

Extensive field and laboratory observations were made to determine (1) the effect of various sand gradations on the workability of the concrete and the appearance of the surfaces; and (2) just what effect various air entraining admixtures would have with the mixtures containing the various sand gradations. As a result of the above observations, it was decided to modify the construction contract, at an increased cost to the Government, to allow for a minimum of 8 percent of the blended sand passing the 100 mesh sieve and to provide for an average of 4 percent entrained air in the concrete. This was accomplished by blending 75 percent manufactured sand with 25 percent natural sand and by the addition of 41.5 cc. of a commercial air entraing admixture for each bag of cement in the concrete. This has resulted in a concrete with practically no bleeding, a high degree of workability and plasticity and has produced vastly improved sloping surfaces. It has also resulted in a reduction of cement content for interior concrete from 3.5 to 3.0 bags per cubic yard.

Mixing water is cooled to 35 deg. F. when the air temperature is above 35 deg. and was heated in winter so that concrete always is placed at temperatures between 50 and 75 deg. Two ammonia compressors with 100-hp. motors cool 100 gpm. of water from 85 to 35 deg. when condensing water has a temperature of 85 deg. The 100 gpm. is adequate water for the 3-cu. yd. per min. capacity of the mixer plant. In addition to tempering the mixing water, aggregates are sprayed in summer for cooling and are warmed in winter.

The three mixers dump into a com-

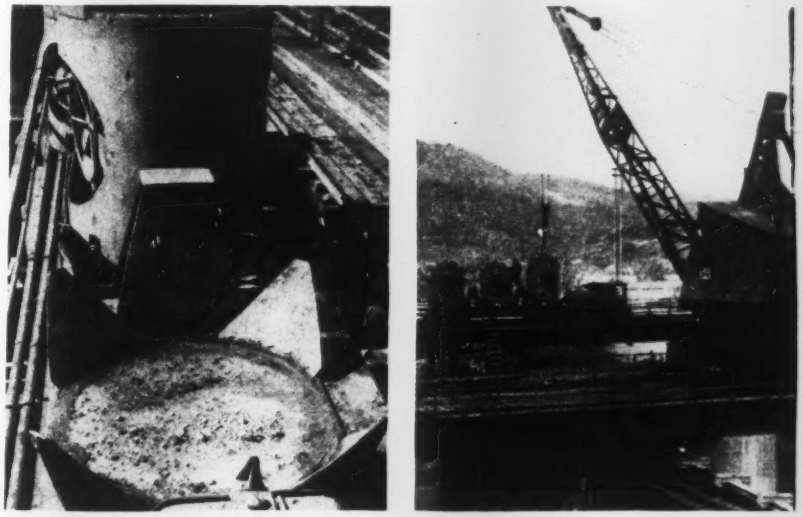


Fig. 6. Welded shapes make basket on 42-in. gage car for whirler to set empty bucket, then shift hook to full one. Note steps between buckets for hook man.

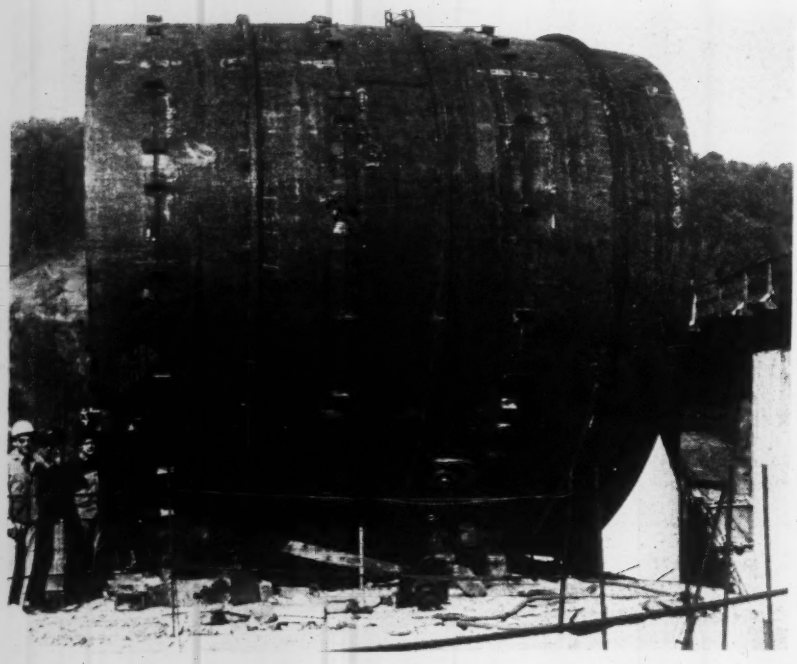


Fig. 7. Penstocks; 19 ft. dia. are set on rollers that permit turning so that all welding can be done downhand.

mon 9-cu. yd. hopper that has an air-operated gate below from which 3-cu. yd. concrete buckets resting on flat cars are filled for delivery to the dam and placing by crane.

Whirler cranes, eight of them, do the lifting at Bluestone Dam. Six of the whirlers are on the dam proper, one serves the material yard and the other, as noted above, handles the aggregates. All of the units are electric powered and most of them have electric travelling motors driving the double-flange rail wheels. The rig handling aggregates has a 20-ft. dia. track circle, two rigs have 17-ft. dia. track circles and five have 14-ft. track circles. Seven of the whirlers were built by the contractor's manufacturing division.

The smaller units will handle a 3-cu. yd. bucket of concrete, about 8 tons, at 65-ft. radius and the larger unit will handle it at about 35 ft.

For concrete placing, the whirlers were set first at about El. 1401, operating without gantries to place concrete down to the deepest excavation at about El. 1326. The whirlers are supported on 8-ft. dia. unreinforced concrete columns poured in place as permanent concrete in the dam. These concrete piers are spaced to avoid joints and permanent steel. They are positioned so that the whirlers reach the concrete delivery track and to the upstream face in one swing. Concrete in the extended apron sections is handled from a whirler working on the foundation rock, supplemented by crawler cranes.

As concrete reaches the level of the whirler tracks, additional 33-ft. lifts of columns are placed, frequently further upstream but within the permanent concrete, to carry the cranes at a higher level. The bridge supporting the cranes is lifted in sections and reset at the new height. The whirlers are raised in five pieces—the boom, counterweight, cab with hoist, rotating table and base—by another whirler unit.

As shown in Fig. 4 the whirler in the power house section will be raised probably five times in construction of the dam. For other areas the number of raises will be less but all are governed somewhat by shortage of steel that might be used for an outside trestle.

Raising whirlers has become a rather routine job at Bluestone and requires only 12 hours with a crew of 6 men and the services of another rig.

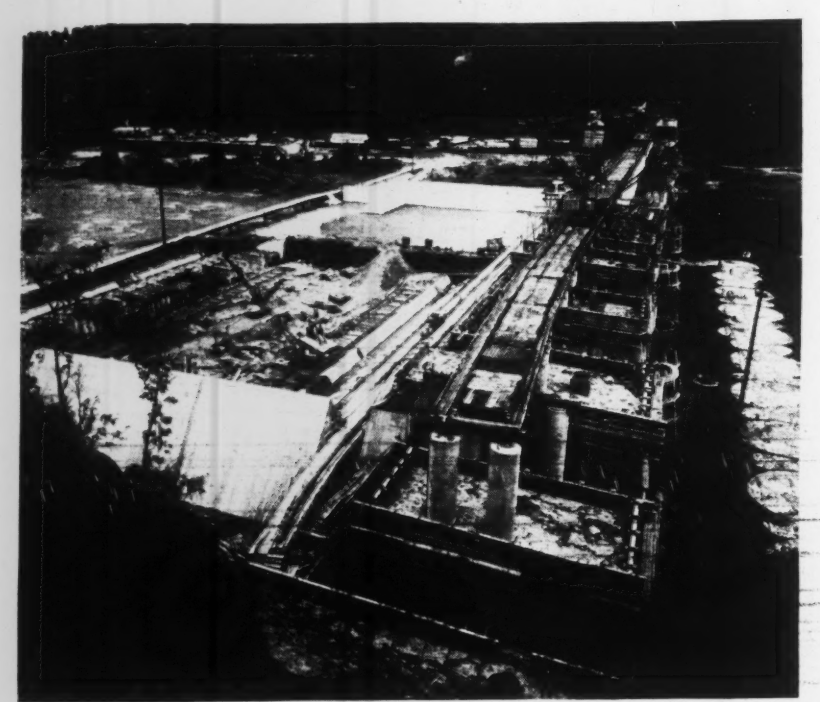


Fig. 8. An unusual element of Bluestone Dam is the long stilling pool below the spillway, here shown under construction. It is being formed by building a 23-ft. high concrete weir 360 ft. below the axis of the main dam.

Concrete hauled by dinkey

Narrow-gage trains deliver concrete on the dam at one level, El. 1401, the maximum elevation for loading 3-cu. yd. buckets under the mixers. It was at one time planned to "jump" the concrete delivery track to a higher

Fig. 9. The construction bridge from which cranes place most of the concrete is here shown at an intermediate level.

elevation to avoid the time loss of hoisting each bucket of concrete as work concentrated near the top. Steel for a trestle was very difficult to get and concrete had to be hoisted from the mixers to the higher level anyway so no change will be made.

Two 3-cu. yd. buckets are set on 42-in. gage flat cars that have space for a third bucket. The loaded cars are delivered to a whirler at the point of placing by a diesel "dinkey" operating over the double-track trestle. The whirler sets an empty bucket in the third position on the car and the open hook is shifted to a full bucket. After the second bucket is picked up the train moves back to the mixer plant for a new load and the last empty bucket is set on the next car.

Concrete buckets used were manufactured by the contractor. They are manually opened with a wheel inset into the side of the bucket. The bottom dump-gate is counter weighted so that it closes automatically but is positive and tight in closing.

Concrete is placed in 5-ft. lifts in cantilever forms made up with very heavy (4-in.) vertical sheathing, a top and bottom stud, and vertical wales of a double-12-in. channel or single 14x16 timber following the pattern set by the same contractor at Mahoning Dam, (*ENR* Oct. 23, 1941 vol. p. 554). For lifts near the rock or locations where there is not room for the cantilever beam below the lift being placed, a form with internal diagonal ties connected to a movable fitting over a channel top wale, the type developed by the Tennessee Valley Authority at Hiwassee Dam, is used.

Special forms for sluiceways and the like are made up at a very well equipped carpenter shop. They are delivered to the placing site by the narrow-gage railway and swung into place by the whirlers.

Heat keeps absorptive liner dry

Forms for all faces of concrete to be in contact with flowing water such as the spillway, intakes, and baffle piers are faced with a thin, absorptive lining before concreting. The contractor have found that the moisture absorptive qualities of this lining cause buckling in advance of concrete placing and make use of the liner time consuming and expensive. The absorptive material is put on just prior to concreting and after the block is cleaned. Even then, the lined forms are covered with a tarpaulin and a 200-watt light put under the cover for each 20 x 5 ft. area, to provide heat and prevent moisture reaching the liner.

Concreting regularly is done on the 4 p.m. to midnight and midnight to 7:30 a.m. shifts to leave the handling equipment available for other uses during the day. Concrete is placed very dry and vibrated with large immersion-type electric units operated at a frequency of vibration of 7,200 by changing the power source to 120 cycle with frequency converters.

Vertical lifts in the dam are limited to 5 ft., less near the rock. At least five days must elapse between successive lifts in the same monoliths and concrete must be placed in alternate rather than successive monoliths to assist further in keeping down the heat of hydration in the concrete. An air and water jet is used, just as the concrete is attaining its final set, to cut laitance from the top surface of each pour. Curing is done by water sprays from adjustable nozzles for a period of 14 days. When winter temperatures require it, steam curing is provided.

During the several years of planning and construction, the Huntington District of the Corps of Engineers has had a number of executive officers in charge of the project, but Harry Pockras, chief civilian engineer in the district office and war-time district engineer with the rank of lieutenant colonel, has had the continuing responsibility of directing design and construction. Colonel A. M. Neilson is now district engineer.

R. B. Jenkinson is resident engineer on the construction: A. C. Hooke is assistant resident engineer and Homer Thrall is concrete technician. J. J. Conrad is in charge of the construction division of the district office.

The Dravo Corporation of Pittsburgh is building the dam under a $11,376,000 contract.

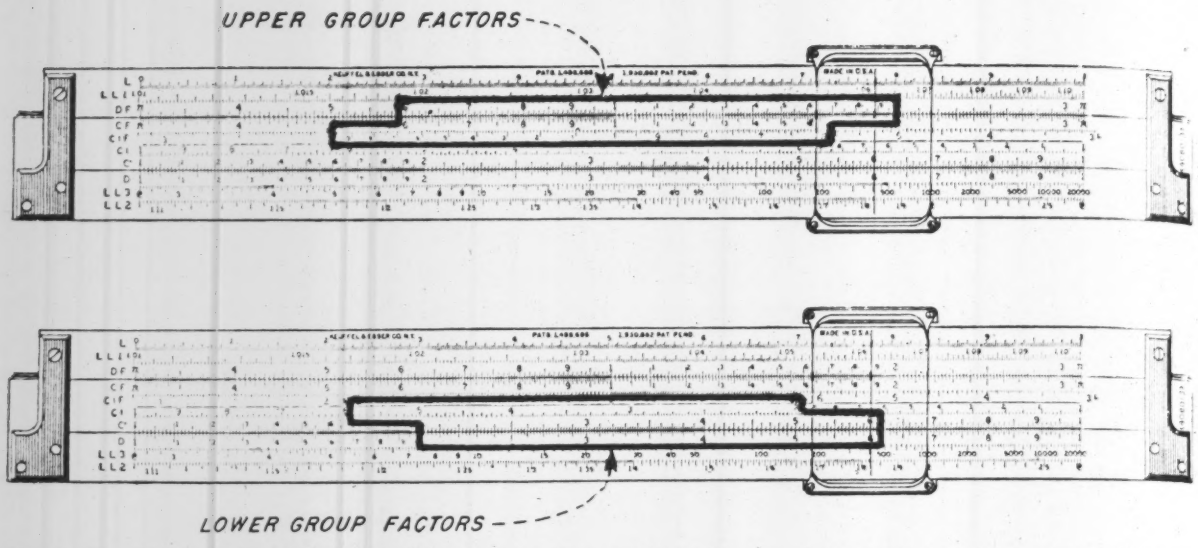


Fig. 1. The "Center-drift method" of slide-rule operations requires the use of an upper and lower group of figures.

How To Speed Up Slide-Rule Work

Lee Johnson
Dean, School of Engineering
University of Mississippi
University, Miss.

***Contents in Brief**—An improved slide-rule procedure has been worked out by Dean Johnson who has given it the name of "Center-drift method." This operation permits more efficient use of a familiar tool by substituting the eye and the head for the hand. Compared with orthodox procedure, it requires one third the amount of movement and about half as much time.*

THE MODERN engineer's slide rule with its ingenious arrangement of many scales is a very versatile tool for the solution of computations requiring no more than "three-place accuracy". This is particularly true of the duplex type of slide rule which has both the regular scales, *D*, *C*, and *CI*, and the folded scales, *DF*, *CF*, and *CIF*. The duplex rule with these six scales can be used with great efficiency in the solution of multiplications, division, and combinations of multiplication and division of numbers. By judicious use of scales, operations can be performed with a minimum of settings and without running off the rule and having to reset the slide in the midst of an operation.

Two basic procedures lead to efficient operation: (1) dividing all numbers into two groups called the "upper group" and "lower group"; (2) using the inverted scales, *CI* and *CIF* for multiplication and division with the scales, *D*, *C*, *DF*, and *CF*.

Numbers are divided into two groups according to their position on the upper and lower groups of scales, the upper group consisting of the *DF*, *CF*, and *CIF* scales and the lower group of the *D*, *C*, and *CI* scales. The "upper group" of numbers are those beginning with 6, 7, 8, 9, or 1 since such numbers fall approximately within the middle half of the rule on the upper scales. The "lower group" of numbers are those beginning with 2, 3, 4, and 5 which fall approximately within the middle half of the lower scales. These two groups of figures are illustrated in Fig. 1.

Use of the *CI* scale for multiplication and division is quite old and is mentioned in most manuals and texts on the slide rule. The advantage of using the *D*, *C*, and *CI* scales over just the *D* and *C* scales is illustrated by performing the product $3 \times 4 \times 2$. Using only the *D* and *C* scales, the operation can be outlined as follows:

Product $3 \times 4 \times 2$:
Runner to 3 on *D*
Slide to right index (right end of slide)
Runner to 4 on *C*
Slide to left index (left end of slide)
Runner to 2 on
Read 24 on *D*.

The total movement required for this operation is 1.8 scale lengths. Using the *CI* scale also, the operation can be done in 3 settings instead of 5:

Product $3 \times 4 \times 2$:
Runner to 3 on *D*
Slide to 4 on *CI*
Runner to 2 on *C*
Read 24 on *D*.

Fig. 2. In the classroom Dean Johnson demonstrates the use of his improved method with a mammoth slide rule.

The total movement required is 0.2 scale length. Using the *CI* scale requires fewer settings, less movement, and no awkward settings at the end of the slide.

The *CI* scale does not always lead to such efficiency. On the lower scales, the operation sometimes runs off of the rule and requires a resetting of the slide:

Product $11 \times 12 \times 13$:
Runner to 11 on *D*
Slide to 12 on *CI*
Runner to right index
Slide to 13 on *CI*
Runner to right index
Read 1716 on *D*.

The total movement is 1.65 scale lengths. Likewise, if only the *D* and *C* scales are used, 5 settings are required. However, these factors all belong to the "upper group" and are close to the center of the rule on that group of scales. If this computation is performed on the upper scales, only 3 settings are required:

Product $11 \times 12 \times 13$:
Runner to 11 on *DF*
Slide to 12 on *CIF*
Runner to 13 on *CF*
Read 1716 on *DF*

The total movement is 0.32 scale lengths.

Most efficient operation results when the runner and slide are moved as little as possible, this occurs when factors are chosen as close to the center of the rule as possible. In setting factors there is a choice between the upper and lower scales, and at the beginning of a computation, upper group factors should be set on the upper scales, and lower group factors on the lower scales. As an operation progresses, choose between the upper and lower scales so as to keep drifting toward the center of the rule. The method might be termed a "center-drift" method.

– Four general rules apply:

(a) Always begin and end a computation with the runner. The first movement or setting is always made with the runner and the final movement or setting is likewise made with it.

(b) Always begin and end a computation with a setting or reading on one of the two *D* scales, either the lower *D* scale or the upper *DF* scale. Whether to begin or finish on the lower *D* scale or the upper *DF* scale will be explained in the next section.

(c) Concerning movement of the runner, there is always a choice of setting the runner either on a factor in the upper group of scales or on the same factor in the lower group of scales. This is generally true every time the runner is set.

(d) Concerning movement of the slide, the runner and slide are always moved as a pair with the runner first and the slide next. The movements of runner and slide constitute a game of "Follow the Leader" with the runner as leader and the slide always following. If the runner is set on the upper scales, the slide must follow to the upper scales; if the runner drops to the lower scales the slide must follow to the lower scales. Whichever group of scales the runner chooses, the slide must follow it to that group. The runner is never moved twice in succession, nor is the slide, but they are always moved as a pair to the same group of scales, except for the first final movement or setting of the runner.

In division, such a computation as follows would be most efficiently performed on the upper scales:

$$\text{Division: } \frac{888}{12.2 \times 9.31}$$

Runner to 888 on *DF*
Slide to 9.31 on *CF*
Runner to 12.2 on *CIF*
Read 7.81 on *DF*.

The total movement is 0.13 scale length. Another example is:

$$\text{Division: } \frac{2980}{3.17 \times 4.08 \times 3.43}$$

Runner to 2980 on *D*
Slide to 3.17 on *C*
Runner to 3.43 on *CI*
Slide to 4.08 on *C*
Runner to upper index (nearer than lower indices) Read 67.2 on *DF*.

The total movement is 0.34 scale length.

Reviewing the preceding examples which are either a series of products or of divisions, it is observed that after setting the first factor on a *D* scale, either upper or lower, the remaining factors are all set on the slide scales and in alternating order between the *C* scales and the *CI* scales. For multiplication, the order is *D-CI-C-CI-C*-etc., and for division, *D-C-CI-C- CI*, either on upper or lower scales or on both sets. The reverse is true for alternating operations such as division, multiplication, or division, in that the scales on the slide are repeated.

Steps are outlined

These rules can be summarized as follows:

After setting the first factor on a *D* scale, the remaining factors are all set on the slide scales as follows:

For repeating operations, alternate scales (between *C* and *CI*)

For alternating operations, repeat scales (either *C* or *CI*)

To start with multiplication, use *D* and *CI* scales

To start with division, use *D* and *C* scales.

An illustration of the rule for alternating operations is given by the following combination of multiplication and division:

$$\text{Combination: } \frac{37.3 \times 12.2}{4.63 \times 8.13}$$

Runner to 37.3 on *D*
Slide to 4.63 on *C* (Division)
Runner to 12.2 on *CF* (Multiplication)
Slide to 8.13 on *CF* (Division)
Runner to upper index
Read 12.1 on *DF*.

Note that as the operation alternates between division and multiplication, the *C* scales (either *C* or *CF*) on the

slide are repeated. Note also how the operation jumps from lower to upper scales to keep runner and slide close to the center.

A general illustration of the method to show its efficiency is given by the following computation:

$$\text{Combination: } \frac{8.16 \times 11.4}{2.85 \times 3.29}$$

Solve by taking the two upper group factors first and then the two lower group factors:

Runner to 8.16 on *DF*
Slide to 11.4 on *CIF* (Multiplication)
Runner to 3.29 on *CI* (Division)
Slide to 2.85 on *C* (Division)
Runner to upper index
Read 9.94 on *DF*

The reader should not conclude that a computation composed of all upper scale factors should be done entirely on those scales.

The "center drift" idea controls the operation above all else. For example:

Product: $15 \times 16 \times 18$
Runner to 15 on *DF*
Slide to 16 on *CIF*
Runner to 18 on *C*
Read 4320 on *D*.

Although all of the factors are upper scale factors, it is not only desirable, but necessary to move to 18 on the lower scales which brings the runner back toward the center.

In all cases the decimal point is set by inspection. Factors are "rounded off" and multiplied mentally or cancelled where possible.

Another short cut is suggested for operations with an even number of factors in which the answer is read opposite an index. With practice the operator can learn to read the answer opposite the index by eye without setting the hairline on it, thus substituting a movement of the eye for the final movement of the runner.

Fiber Tubes Imbedded in Concrete Slab Increase Effective Span

E. R. Schofield
Principal Assistant Engineer, Department of Public Works
Philadelphia, Pa.

In the design of concrete bridge decks, Philadelphia's Division of Engineering has successfully used fiber tubes between reinforcing bar trusses to reduce dead load, and thereby, to gain strength. By use of this procedure, it has been possible to extend spans 10 percent.

In the past, Philadelphia has built many bridges in which reinforcing steel trusses were used in deck slabs. These trusses were made up of two tension and two compression bars tied together with a diagonally-bent rod. In the shop these trusses were assembled into mats of convenient handling size by the addition of transverse temperature rods. The mats then were shipped to the job, quickly slid into position, and welded into a continuous framework.

With top and bottom steel it was felt that some concrete could be omitted at the neutral axis where, serving no useful purpose, it actually added useless dead load to the deck. By inserting a $5\frac{5}{16}$ in. outside dia. cardboard tube between trusses, it was possible to increase the strength of the slab without increasing weight so that the span could be extended from 10 to 14 ft.

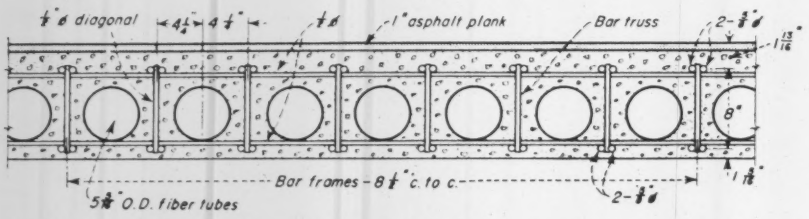


Fig. 1. Fiber tubes imbedded in the bridge deck between reinforcing steel trusses lessen the dead load so that span may be increased.

The fiber tubes, $\frac{3}{32}$ in. thick, were made of seven plies of jute fiber stock spirally wrapped with asphalt impregnated paper permanently fixed with waterproof glue. A paraffin coating then was applied by dipping. Finished tubes were strong enough to carry a load of 21 lb. per lin. in. or the weight of a 150-lb. man concentrated on one foot without failure. The sections, made in ten-foot lengths, were fastened together with rubber tape. Wooden plugs were used to close off open ends.

When this design was first carried out, some uncertainty existed as to how concrete would flow around the tube. Therefore, the contractor was required to set up a sample panel and make a test pour. A close inspection of the bottom of this slab showed that the concrete had flowed perfectly around the tubes and that no honeycomb had formed, the success of this operation being due to proper vibration. The concrete mix contained one part of cement, 1.3 parts of fine aggregate, and 2.5 parts of $\frac{3}{4}$-in. gravel with sufficient water to produce a slump of 5 to 7 in.

With the successful completion of this test, the bridge floor was built with fiber tubes between reinforcing bar trusses as shown in Fig. 2. This bridge located at the Margaret-Lefever street crossing of Frankford Creek has proved to be entirely satisfactory after three years of service. As a result a similar design has been drawn for the new bridge at Sedgley Ave., a contract for which was recently let to the James McGraw Co.

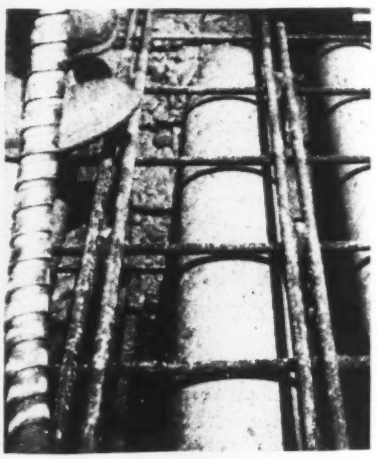


Fig. 2. Use of vibrated concrete with 5 to 7-in. slump insured flow under tubes.

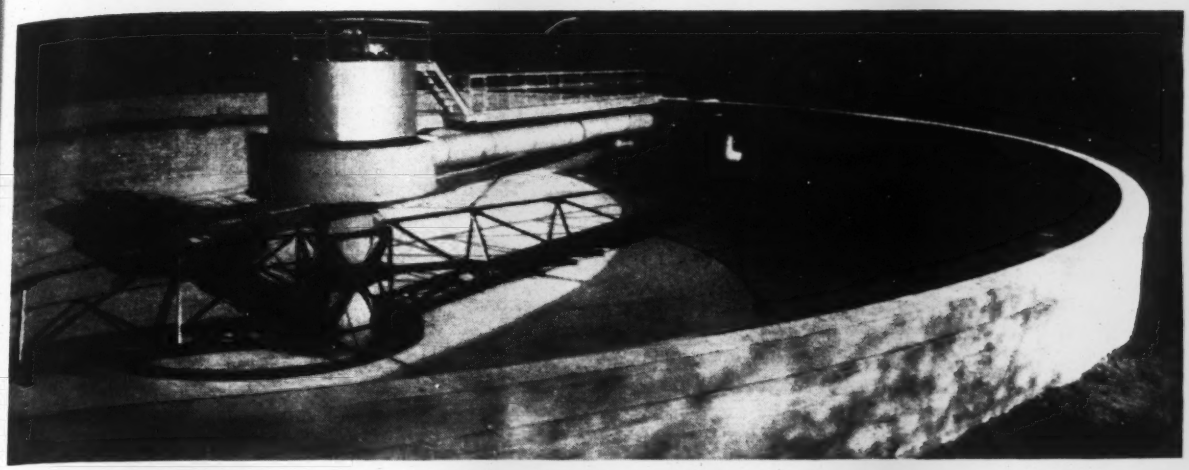


Fig. 1. Raw water enters from the center well and passes to the peripheral weir suspended from the wall on brackets. Sludge is propelled continuously towards a central well by a rotating collector.

Triple Sedimentation Employed To Condition Culm Laden Water

S. I. Zack
Sanitary Engineer
Gannett Fleming Corddry and Carpenter, Inc.
Harrisburg, Pa.

***Contents in Brief**—Heavy suspended solids carried over from the primary into secondary settling tanks, and manual sludge removal procedures incurring frequent shutdowns led to the installation of an additional clarifier by the water company at Norristown, Pa. Fitted with effluent channels offset from the wall to double the length of the overflow weirs, and with a rotary collector for continuous removal of sludge, the new installation is designed to handle water with turbidity as high as 25,000 ppm, to obviate operating nuisances, and to step-up output.*

THREE functional difficulties confronted the operators of the Norristown, Pa. treatment plant, which receives water heavily loaded with coal culm. First, heavy suspended solids accumulated rapidly in the primary settling tanks; and this sediment was constantly carried over into secondary sedimentation units, particularly during periods of high river run-off. Second, removal of sludge accumulated by hand scrapers in the primary tanks required considerable labor. And third, flushing of sludge in the lower or secondary basins (undrainable during operation) necessitated frequent shutdowns involving half of the plant settling capacity.

Providing triple sedimentation by the installation of an additional clarifier (110 ft. in dia.) for pre-treatment of the raw water insured continuous sludge removal, and provided uninterrupted operation with a consequent increase in plant capacity.

The basic problem was the removal of heavy sediment picked up by the Schuylkill River in its meanderings through the anthracite coal district. Normally turbidity of raw water averages 1,000 ppm., but during times of heavy precipitation and run-off this count may be as high as 25,000 ppm. Yet, during dry weather this value drops to as low as 25 ppm.

Treatment facilities at the plant provided primary sedimentation, aeration, filtration and sterilization. The primary tanks, two in number, each 30 by 150 ft. and with a water depth of 2 ft., are located directly above the secondary basins. Here at rated capacity the detention period is 16 min. and the velocity 0.16 fps.

Cast iron plate aerators set at about 45 deg. extend from the primary to the secondary tanks. The surfaces are ribbed at various angles to create maximum turbulence.

The two secondary settling basins, 65 ft. wide and 130 ft. long with a 10.7 ft. water depth, provide at designed capacity a detention period of 2.7 hr. and a flowing-through velocity of 0.028 fps. These tanks are covered completely by the primary channel, and their floors slope to a center drain connected to the main sewer.

Filtration is provided by twelve beds, each 22 by 14 ft. and containing nine in. of gravel and 27 in. of sand.

Chemical feed equipment applies line, alum, activated carbon and chlorine at definite points. Lime and alum, introduced into the suction of raw water pumps, are the coagulating agents. Normally, 1 gr. per gal. of

alum, and ¾ gr. per gal. of lime are consumed, but to handle high turbidity, these amounts are tripled. Activated carbon is added at the influent chamber located immediately ahead of the primary settling tanks, and chlorine into the filter influent. When conditions require, chlorine and carbon are supplied to raw water.

Flocculation beginning at the inlet of the upper settling basins continues to develop effectively until tumbling aeration causes its partial destruction. Re-formation, however, sets in and sedimentation is completed in the secondary tanks. After filtration the treated water is of an acceptable bacteriological quality and free of turbidity, taste and odor.

Operational difficulties arose from three facts: the shallow tanks filled rapidly with sediment; velocity was high enough to carry over large amounts of heavy suspended solids into the final basins; and, sludge in the upper tanks only could be removed manually, and in the lower tanks by flushing into small drains.

Some mud could be removed from the upper basins during operation, but for complete removal of sludge from the lower settling basins shutdown of that unit was required. Although these shutdowns were not of long duration, they were frequent and required considerable labor.

To eliminate these difficulties, a clarifier, 110 ft. in dia., with a low side-water depth and with an inverted

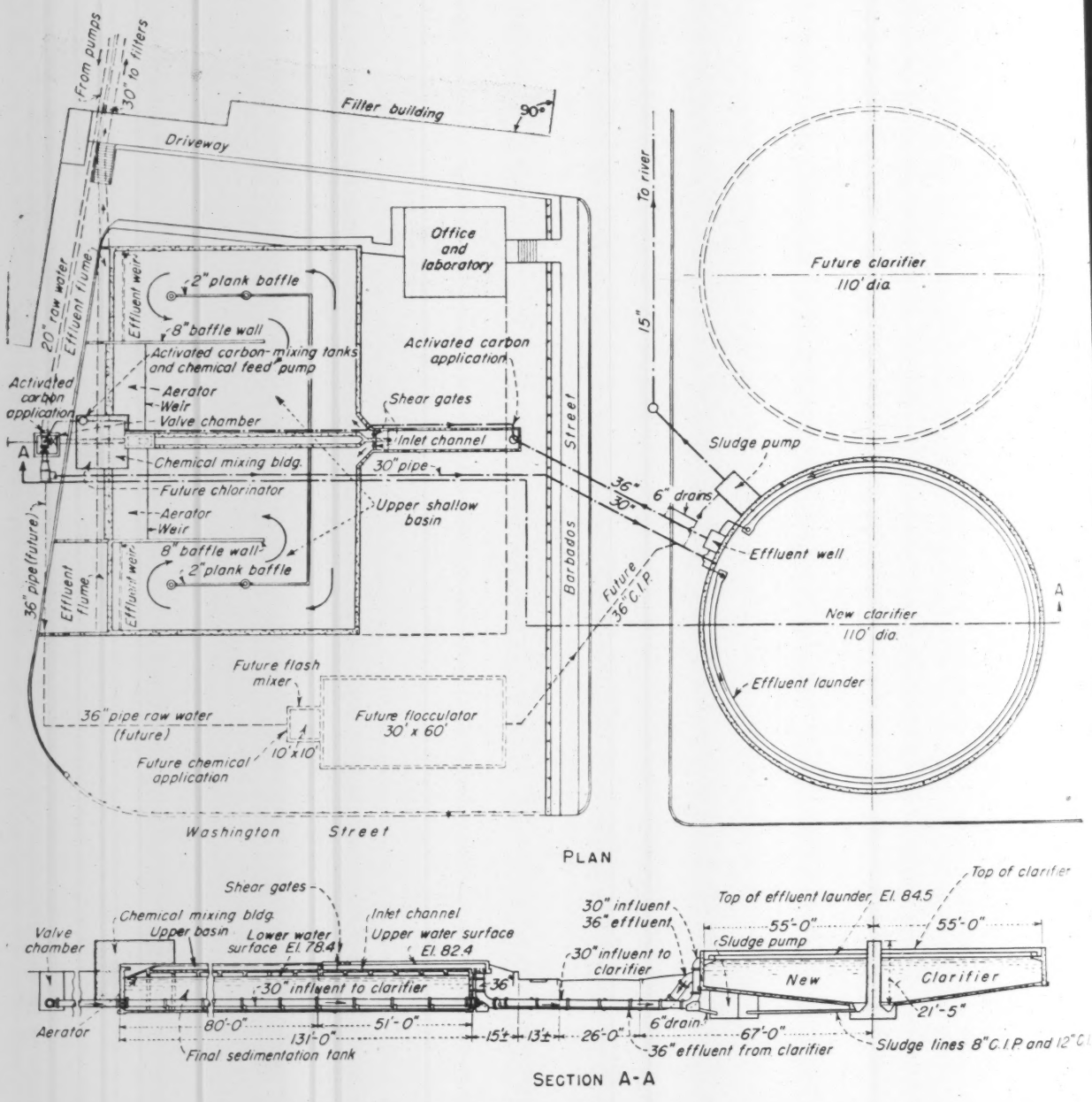


Fig. 2. The new clarifier provides the first step in triple sedimentation. Additional wood baffles eliminate short-circuiting in the primary settling tanks. Activated carbon may be applied before or after clarification.

cone bottom for sludge collection and removal was installed. It is designed to handle 12 mgd. with an overflow rate of 1,265 gal. per sq. ft. per day. The volume contained within the cylindrical portion provides a detention period of 85 min.

The feed well is located at the center, and effluent channels with adjustable steel plates on each side are placed 2.5 ft. from the wall along the entire inner periphery of the tank. This latter feature is noteworthy in that both edges are used as overflow weirs. Sludge, moved steadily to the center by scrapers rotated by an extra-heavy industrial type drive, is withdrawn by means of gravity.

In the modified scheme the clarifier has been inserted at the beginning of the process. To it a 30 in. pipe brings water from intake pumps, and from it a 36 in. line conveys its discharge to a new inlet channel that distributes flow to either primary settling tank. Additional wood-plank baffles installed in the primary tank transform its effective shape from nearly square to long, narrow rectangular, provide lengthened passage, and eliminate short-circuiting. Thereafter, water cascades over the aerator into the secondary settling tank and continues to the filter.

Sludge removal equipment

Design of sludge removal facilities is based upon a maximum anticipated removal of suspended solids amounting to 25,000 ppm., a condition that will produce sludge at the rate of 1,040 gpm.; normal flow containing about 6,000 ppm. will accumulate 500 gpm. of sediment; and the minimum rate of 25 ppm. will produce 10 gpm. Under the lowest figure sludge might be withdrawn intermittently.

Two pipe lines, 12 and 8 in. dia., with a 4-in. branch extending from the 8 in. have been installed to withdraw sludge. Each pipe is separately valved and fitted with connections to provide flushing. Three discharge lines reduce throttling and prevent interruption of withdrawal in case of clogging. These pipes discharge into a common sump from which a 15 in. gravity sewer extends to the river.

A rotating collecting mechanism of the extra-heavy industrial type was selected to move thick sludges (containing as much as 20 percent solids anticipated under peak conditions) continuously to the center collection well. Stalling of the mechanism due to heavy sludge accumulations is prevented by an automatic device which raises the scrapers as the mud thickens. The top layers of heavy sludge concentrations are then skimmed off consecutively until the low, normal position is reached. Moreover, should overloading occur at the highest elevation, an alarm is sounded, which, continuing unattended, shuts off the operating motor. Normal overloading may be prevented by increasing the rate of withdrawal; but once rotation has ceased, the cause must be determined, corrected, and the motor restarted manually.

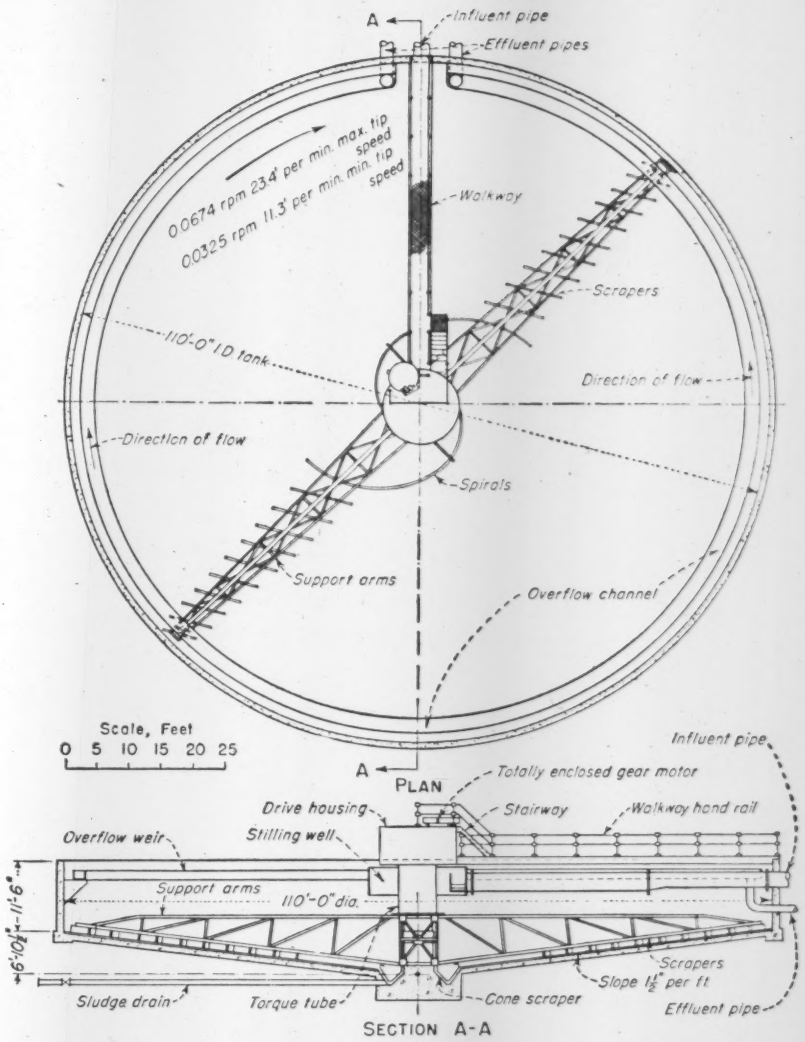


Fig. 3. Effluent channels suspended 2.5 ft. from the inside face of wall utilize both edges as overflow weirs. The extra heavy sludge collector is protected from overloading damage by an automatically-controlled device that lifts the scraper as sediment thickens. It then skins off succeeding top layers descending gradually to the normal position.

The only change in the chemical process will be the preparation of a suspension of activated carbon to be injected into the clarifier influent. Under certain conditions better utilization of carbon will be obtained by addition after removal of heavy solids. Therefore, provision has been made to add the mixture at the entrance to the upper settling basins.

Improvements to this plant were financed by the Norristown Water Co., Norristown, Pa. of which W. F. Zimmerman is president and Brinton Russell is superintendent of operations. For Gannett Fleming Corddry and Carpenter, Inc., the author directed design and construction.

Fig. 1. Low-cost veterans' housing at Painesville, Ohio is a joint venture of capital, constructor and purchaser.

Contractor, Architect, Realtor and Banker Join Hands On 50-Unit Housing Plan

***Contents in Brief**—Nearing completion at Painesville, Ohio is a 50-unit veterans' housing project, financed and built under private auspices through a cooperative arrangement. Built to sell for less than $6,000, each house will require some final finishing by the purchaser.*

A PRACTICAL APPROACH toward meeting the need for low-cost housing is demonstrated in a 50-unit project that was completed ready for occupancy early this spring, just outside of Painesville, Ohio. Financed and built under private auspices, this veterans' housing project is notable more for its manner of execution than for the fact that the radiant-heated, four-room houses with attached garage and utility room cost the veteran only about $6,000 plus a limited amount of his own labor.

This attractive plan of relatively low-cost home ownership is a joint venture of a small group of business men in Cleveland and Painesville who believe that the prime requisite of any veterans' housing project is minimum shelter with a sufficiently low initial cost to protect the owner against all but a catastrophic drop in real estate values. Yet it should be of such a type that the veteran can add to its value by his own efforts over a period of time.

That such a plan would be feasible was based on experiences of the Cleveland Trust Co. During 1937 and 1938 this bank financed the construction of some 500 minimum-shelter houses in Northern Ohio with loans aggregating $1,250,000. Outstanding indebtedness on these houses to date totals only $177,000, with but one owner defaulting on his mortgage.

Incidentally, the term "minimum shelter" is a misnomer as applied to the veterans' housing project in Painesville. At the time of sale they furnished comfortable living quarters including all contemporary conveniences—with only a few "extras" to be added by the purchaser.

Briefly, the successful completion of this venture is the culmination of profit-cutting from start to finish, implemented by enthusiastic cooperation on the part of the contractor, the architect, the realtor and the financing agency.

To be specific—the contractor operated on a cost-plus-ten-percent basis which included his insurance, workmen's compensation, social security and other taxes, together with his own overhead.

Architectural plans, which include two types of floor layout and six different exterior treatments, were prepared for a fixed fee of $10 per house. The realtor's compensation is limited to $50 per house instead of the usual percentage charge based on the sale price. The Cleveland Trust Co. financed construction of the project at a three percent interest rate, including the cost of the site and 80 percent of the cost of bringing water in from the Painesville municipal system; the remaining 20 percent of water installation cost was borne by Painesville Township.

Non-profit corporation

At the inception of the program, a non-profit corporation, called Painesville Civic Housing, Inc., was formed, with a $500 capital structure. It was empowered to borrow funds necessary to acquire a building site and to construct the houses. Upon completion and sale of the last house, its accounts will be audited and all remaining funds will be refunded equally to the 50 home owners.

Although the current sale price for each house, including a 60 x 200-ft. lot, is $6,400 or $6,500 depending upon the type of house purchased, the amount of refund is expected to exceed $500 per house. This will make a net cost to the veteran-owner of slightly less than $6,000. If 100-

percent financed at four percent interest over a 20-year period, his mortgage payments will be $36.36 per month, plus about $5 per month for taxes and fire insurance. It is reported that the Cleveland Trust Co. will furnish 100-percent financing of these houses for the veteran, if necessary.

Basically, the houses are built to a single floor plan measuring 26 x 26 ft. overall, with a 14 x 20-ft. combination garage, laundry and utility room attached at one end. By reversing this plan, another floor plan was secured which, together with six exterior plans gives a sufficient variety to eliminate any monotony of arrangement found in the ordinary block-type housing project. Another feature is to stagger the setback from the street to break up the continuity of roof lines. Some houses are set back 40 ft. from the street line while others have a 50 ft. set-back.

Radiant heating in floor

Each house contains two bedrooms, 10 x 12½-ft. and 9 x 11½-ft.; and an 8 x 12½ ft. kitchen, a bathroom and a 15 x 12½-ft. living room. Floors are concrete, 4 in. thick, in which are embedded piping for radiant heating furnished by an oil-burning heater. Foundations are 8-in. concrete walls extending 3 ft. below the ground.

Structurally, the houses are timber frame, with 2x4-in. studding, 2x6-in. ceiling joists and 2x6-in. rafters, all spaced 16 in. c. to c. Exterior wall finish is 8-in. red cedar shiplap on ½-in. sheathing-grade plywood, without building paper or other insulation. Interior finish is rock lath and plaster. Roofs are asbestos shingles on ⅝-in. sheathing-grade plywood. All houses are given two exterior coats of paint.

At the time of sale, each house had been completed to a point where it furnished adequate and comfortable shelter for the purchaser. Then, with the addition of about $200 worth of material plus an estimated $600 worth of labor by the purchaser, the house could be completely finished.

The motives behind the decision to leave part of the work to be done by the veteran who buys one of these houses were: (1) minimize the cost of construction; and (2) increase the pride of ownership through participation in the physical construction of the house.

Fig. 2. Exteriors are red cedar shiplap on a sheathing grade of plywood, foundation walls are concrete and roofs are asbestos shingles.

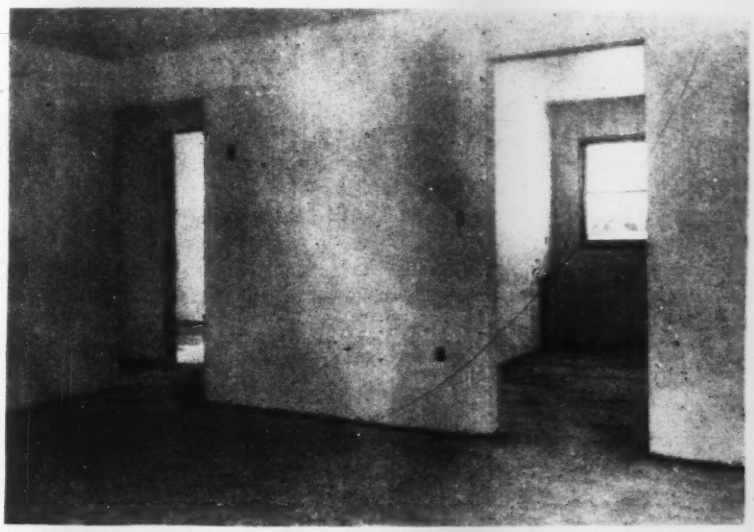


Fig. 3. Interior walls are rock lath and plaster on 2x4 studs, while floors are concrete containing pipe for radiant heating.

Work remaining to be done by the purchaser does not require special skill. It includes adding a cemented-plywood and carpet, an asphalt-tile or a linoleum finish to the concrete floors; building some additional kitchen cabinets and one guest clothes closet; completing a linen closet and installing all closet doors; adding gutters and downspouts; and completing such interior trim as picture molding, etc. Base boards and the major items of interior trim were installed under the construction contract.

Under the construction contract, which was performed with union labor, water was piped into each house, and bathroom fixtures such as lavatory, toilet and tub were connected. The houses are completely wired for electricity and all fixtures are included. Cooking must be done with electricity since gas is not available at the site.

No sidewalks are to be installed on the project, either now or in the future, but the two-block long street separating the two rows of houses is to be hard-surfaced by Painesville Township. Sewage disposal is by individual septic tanks instead of a common sewer system.

Among those who cooperated in this joint venture are: George B. Payne, contractor; J. Wallace Green, architect; and Milton Ludwig, realtor —all of Painesville. The Cleveland Trust Co. is represented by H. R. Templeton, vice president, Cleveland, Ohio and Alfred Tame, assistant vice-president at the company's bank in Painesville.

Does Torque Weaken Bolts?

H. O. Hill
Assistant Chief Engineer, Bethlehem Steel Co.
Bethlehem, Pa.

***Editor's Note**—Tests made on bolts show that full strength in tension is retained, even when torque is applied, unless the torque loading is carried to bolt failure. This article originally appeared in Fasteners, Vol. 4, No. 1, a publication of the American Institute of Bolt, Nut and Rivet Manufacturers, and is reproduced with permission.*

WHEN bolts are used in flanges and other pressure applications, a rather low tensile stress has often been specified for the bolts, because the loading is applied by turning a nut, which produces torsional shear in addition to tension in the bolt. Recently, tests were conducted to determine if there is a reduction in tensile value and the amount, when bolts are tightened in the usual manner.

In actual practice, when a workman tightens the bolt in a flange, he usually pulls on the wrench until he feels the bolt "give," which is, no doubt, at the yield point of the material. The question to be solved is how much tensile value remains in the bolts for clamping purposes after this tightening operation.

Tests were made on galvanized, 11-in. long ⅝-in. and ¾-in. dia. bolts. The bolts had cut threads, square heads (hot formed) and hexagonal nuts. Carbon was 0.15 to 0.24 percent and threads were class 2, coarse thread, series.

Tension applied in three ways

Testing was performed on a 50,000-lb. Riehle lever testing machine at Lehigh University, Bethlehem, Pa. Tension was applied between head and nut by: (1) Straight pull of testing machine. (2) Tightening nut. (3) Combination of (1) and (2).

The area of the threaded portion of the bolts was taken as the mean area, which is the area of a circle whose diameter is the mean of root and pitch diameters.

Test results are given in the accompanying table.

Tests 1, 2, 16 and 17 were tensile tests made on the unthreaded bolt shanks in the machine. Tests 1 and 2 were on ⅝-in. bolts and the others on ¾-in. bolts. The ⅝-in. bolt of test 1 broke at the root of the thread in the machine grip, at an ultimate unit stress of 63,400 psi., based upon the area of the unthreaded shank. The actual net area was a little less than that used in the computation, which slightly affects the accuracy of this test. Test 2 on a ⅝-in. bolt gave an ultimate tensile stress of 72,000 psi. The average ultimate tensile stress for tests 1 and 2 was 67,750 psi. The ¾-in. bolts gave an average ultimate tensile stress of 70,800 psi.

Results of pure tension tests

Tests 3, 4, 5, 18 and 19 were pure tension tests between head and nut in the tensile testing machine. Tests 3, 4, and 5 were on ⅝-in. bolts and 18 and 19 on ¾-in. bolts. The ⅝-in. bolts gave an average ultimate tensile stress of 67,500 psi. and the ¾-in. bolts 70,150 psi. These values check very favorably with the tensile tests made on the unthreaded shanks.

Tests 6, 7, 20 and 21 were tension tests with the loading applied by tightening the nuts. The tensile loading was measured in the tensile testing machine. Tests 6 and 7 were on ⅝-in. bolts and 20 and 21 on ¾-in. bolts. In these tests, no oil was applied to the threads and no washers were used under the nuts. The zinc coating on the threaded shanks may have furnished a slight degree of lubrication. However, there was no zinc on the threads of the nuts. The ⅝-in. bolts gave an average ultimate tensile strength of 47,500 psi. and the ¾-in. bolts 46,800 psi. The type of failure indicated torsional shear.

It was then considered that oil on the threads and a washer under the nut might reduce the torsional shear and thus increase the tensile value of the bolts when pulled to failure by tightening the nuts.

Tests 8, 22 and 23 were similar to tests 6, 7, 20 and 21, with the addition of an application of oil to the threads and a washer placed under the nuts. The ⅝-in. bolts gave an ultimate tensile stress of 51,700 psi. and the ¾-in. bolts an average value of 52,400 psi. These values are about 10 percent higher than those obtained without the use of oil or a washer. Type of failure indicated torsional shear.

The tension values produced by torsion on the nuts as given in tests 6, 7, 8, 20, 21, 22 and 23 are about 68 and 75 percent of the values obtained by pure tension. The 68 percent figure is applicable for the condition without oil or washer, while the 75 percent figure is applicable when oil and washer are used.

Effect of combined loadings

Tests 9, 10, 11, 12, 13, 14, 24, 25, 26 and 27 were conducted by applying a certain amount of tension through tightening the nuts, and then applying pure tension, by means of the testing machine, to failure. Tests 9, 10, 11, 12, 13 and 14 were made on ⅝-in. bolts and 24, 25, 26 and 27 were made on ¾-in. bolts. Tests 9, 10, 11 and 25 were made wthout oil or washer. Tests 12, 24, 26 and 27 were made with oil on threads and a washer under the nut. Tests 13 and 14 had oil on the threads, but no washer under the nuts.

Test 9 was pulled to 5,000 lb by nut torsion and then by pure tension to failure. Test 10 was pulled to 9,000 lb by nut torsion and then by pure tension to failure. Test 24 was pulled to 8,000 lb. by nut torsion and then by pure tension to failure. Tests 11, 12, 13, 14, 25 and 26 were pulled by nut torsion to yield point and then by pure tension to failure.

Test 27 was pulled by nut torsion to the shearing ultimate strength and stopped just before failure. The load was dropped to about 87 percent and applied by pure tension to failure.

In these combination loading tests, the oil and washer increased the final strength about 3 percent.

The ⅝-in. bolts gave an average ultimate tensile strength of 68,620 psi. (omitting test 13 where the shank pulled out of the bolt head). This value is 1½ percent higher than the value obtained in pure tension.

Results of Torsion and Tension Tests on Steel Bolts

Test No.	Nominal bolt diam, in.	Initial diam at point of fracture, in.	Initial area at point of fracture, sq in.	Condition of loading	Special Conditions	Load—pounds		Stress—psi		Failure	
						Yield point	Ultimate	Yield point	Ultimate	Location	Type of Fracture
1	⅛	0.621	0.303	Tensile test of unthreaded bolt shank in tensile machine	None	15,150	19,200	50,000	63,400	Root of thread in grip	Tensile cup and cone
2	⅛	0.612	0.294	Tensile test of unthreaded bolt shank in tensile machine (Shank of test No. 13)	None	——	21,200	——	72,100	Unthreaded shank	Tensile cup and cone
3	⅛	0.536	0.226	Tension between head and nut in tensile machine	None	11,550	15,260	51,200	67,500	Root of thread	Tensile cup and cone
4	⅛	0.536	0.226	Tension between head and nut in tensile machine	None	11,310	15,260	50,000	67,500	Root of thread	Tensile cup and cone
5	⅛	0.536	0.226	Tension between head and nut in tensile machine	None	11,430	15,260	50,600	67,500	Root of thread	Tensile cup and cone
6	⅛	0.536	0.226	Nut torsion to failure	No oil or washer	9,400	11,170	41,600	49,400	Root of thread	Torsional shear
7	⅛	0.536	0.226	Nut torsion to failure	No oil or washer	9,600	10,300	42,400	45,600	Root of thread	Torsional shear
8	⅛	0.536	0.226	Nut torsion to failure	Oil and washer	10,400	11,730	46,000	51,700	Root of thread	Torsional shear
9	⅛	0.536	0.226	Nut torsion to 5000 then machine tension	No oil or washer	12,000	15,230	53,100	67,300	Root of thread	Tensile cup and cone
10	⅛	0.536	0.226	Nut torsion to 9000 then machine tension	No oil or washer	11,500	15,190	50,800	67,200	Root of thread	Tensile cup and cone
11	⅛	0.536	0.226	Nut torsion to yield point then machine tension	No oil or washer	10,300	15,600	45,600	69,000	Root of thread	Tensile cup and cone
12	⅛	0.536	0.226	Nut torsion to yield point then machine tension	Oil and washer	10,380	15,720	45,800	69,600	Root of thread	Tensile cup and cone
13	⅛	0.536	0.226	Nut torsion to yield point then machine tension	Oil—no washer	10,880	15,520	48,100	68,800*	Shank pulled out of bolt head*	
14	⅛	0.536	0.236	Nut torsion to yield point then machine tension	Oil—no washer	10,690	15,840	47,200	70,000	Root of thread	Tensile cup and cone
15	¾	0.765	0.460	Tensile test of unthreaded bolt shank in tensile machine	None	23,400	32,200	50,800	70,000	In grips	Tensile cup and cone
16	¾	0.760	0.454	Tensile test of unthreaded bolt shank in tensile machine	None	23,200	32,100	51,100	70,700	In grips	Tensile cup and cone
17	¾	0.760	0.454	Tensile test of unthreaded bolt shank in tensile machine (Shank of test No. 20)	None	23,100	32,600	50,900	71,700	In grips	Tensile cup and cone
18	¾	0.652	0.334	Tension between head and nut in tensile machine	None	15,180	22,570	45,400	67,500	Root of thread	Tensile cup and cone
19	¾	0.652	0.334	Tension between head and nut in tensile machine	None	16,740	24,370	50,100	72,800	Root of thread	Tensile cup and cone
20	¾	0.652	0.334	Nut torsion to failure	No oil or washer	13,820	14,980	41,400	44,800	Root of thread	Torsional shear
21	¾	0.652	0.334	Nut torsion to failure	No oil or washer	15,660	16,300	46,800	48,800	Root of thread	Torsional shear
22	¾	0.652	0.334	Nut torsion to failure	Oil and washer	15,170	18,510	45,400	55,400	Root of thread	Torsional shear
23	¾	0.652	0.334	Nut torsion to failure	Oil and washer	15,030	16,520	45,000	49,400	Root of thread	Torsional shear
24	¾	0.652	0.334	Nut torsion to 8000 then machine tension	Oil and washer	17,030	23,920	51,000	71,500	Root of thread	Tensile cup and cone
25	¾	0.652	0.334	Nut torsion to yield point then machine tension	No oil or washer	15,660	22,300	46,800	66,700	Root of thread	Tensile cup and cone
26	¾	0.652	0.334	Nut torsion to yield point then machine tension	Oil and washer	15,570	22,330	46,600	66,700	Root of thread	Tensile cup and cone
27	¾	0.652	0.334	Nut torsion to about shear ultimate of 16,040. Load dropped to 14,000 then machine tension	Oil and washer	13,400	16,040 shear 22,350 tension	40,200	48,000 shear 66,800 tension	Root of thread	Tensile cup and cone

The ¾-in. bolt gave an average ultimate tensile strength of 67,925 psi. This value is about 96 percent of the value obtained in pure tension.

The tests were not very numerous and included but two sizes of bolts, but they indicate the following:

When bolts are pulled to failure by tightening the nuts, the ultimate strength in tension is reduced to about 68 to 75 percent of their value in pure tension. The 68 percent obtains when no oil is used on threads and no washer is used under nuts. The 75 percent obtains when oil and washer are used.

When nuts are tightened to any degree, just short of bolt failure, the bolts still have available for resistance to external load all of their original tensile value. The use of oil on the threads and a washer under the nut has no appreciable effect upon this result.

Fig. 1. Apron area at March Fields, where 18-11-18 in. concrete paving is used to carry the heavy wheel loads of today.

Pavement Evolution at March Field

Edward Koehm
Chief, Flood Control Design Section, Corps of Engineers Office
Los Angeles, Calif.

Contents in Brief—*As one of the early army airbases, March Field has gone through an evolutionary development that mirrors the attempt of engineers and construction men to keep abreast of the needs of the airplane as it has continuously increased in size. First earth, then road-oil surface treatments, and finally asphaltic concrete and portland cement concrete were used. In later years emphasis has been shifted from surface to base as the primary factor in the success of runways. Now subgrades more than 2 ft. thick, topped by 18-11-18-in. concrete slabs, are required for 120,000-lb. gross airplane loads, and design criteria are ready for the 300,000-lb. loads of the future.*

AIRCRAFT operation at March Field Army Airbase in California dates back to World War I. The type of airplane then operated produced comparatively small wheel loads and the volume of traffic was relatively light. Therefore, earth runways and taxiways were sufficient. Today, in contrast, there are concrete slabs 11 in. thick on parts of the field. The steps through which this evolution took place are the subject of this article.

Soils, mechanics, the basic science employed in modern design of airfield pavements, may also be dated back to the time of World War I, but it was not until 1936, during the International Conference at Harvard, that the contributions of international authorities on the science of soils mechanics were coordinated and published. Coincidently, the first important pavements at March Field were constructed in 1937. Leading up to this work, an improved apron area was built in stages from 1930 to 1936.

In June, 1930 an area 780 x 1,600 ft. was improved by applying 3.3 gal. of penetrating road oil per square yard of surface. This treatment resulted in an oil-earth mat approximately 3 in. thick. In June, 1931 eight "warm-up" aprons were constructed, consisting of a 1-in. asphaltic concrete surface placed on a 3-in. macadam base consisting of a graded aggregate bound with an asphaltic material. Finally, just prior to 1937 the Northwest-Southeast runway was surfaced with an oil-earth mix approximately 4-in. thick to meet increased aircraft operational needs.

In the meantime, requirements came through for a "three-runway landing field" with runway alignments in the principal directions of the prevailing winds, and the initial step was taken toward laminated cross section

construction, involving surfacing, base-course, and subgrade treatment. A new Northwest-Southeast runway, 4,000 x 150 ft., was the first to be constructed, using a 6-in. base stabilized with emulsified asphalt. The existing oil-earth mat was broken up, 35 to 50 percent disintegrated gravel added, and mixed with the soil to be stabilized. The bottom 1-in. of the runway consisted of this soil mixture stabilized with 10.3 percent of emulsified asphalt. The next 4-in. was stabilized with 5.34 percent of emulsified asphalt. Approximately 1 in. of rock, which varied in size from ¾ in. to chips, was rolled into this in successive layers and given a treatment of penetration emulsion to form the surface.

Next, in 1938, an East-West runway, 4,100 x 150 ft., was constructed with 6-in. stabilized base and a 1¼-in. wearing surface. The base was constructed by adding 35 to 50 percent, by weight, of disintegrated granite to the natural soil and stabilizing it by adding 5.34 percent of emulsified asphalt. The wearing surface consisted of rock, varying in size from ¾ in. to crusher dust, stabilized with 10.3 percent of emulsified asphalt. The following year a North-South runway, 4,000 x 150 ft. w. was built in the same manner as the East-West runway.

Better foundations needed

In 1941 army airfield construction was assigned to the Corps of Engineers and, coincidently, came recognition of the imperative need for better runway foundations.

During the next two years a new Northwest-Southeast runway, 6,850 x 150 ft., as well as five 75-ft. taxiways were constructed of 9-6-9 in. thick concrete pavement on a 4-in. decomposed granite base. The design of these pavements was based upon highway experience, and they were considered adequate for 30,000-lb. gross airplane loads. Transverse grades were quite flat, as it was not known that aircraft could operate on more steeply crowned runway cross sections.

Because of the urgent need of the Army Air Forces for tactical bases and training fields, research work and construction had to proceed together. Emperical methods were a necessary expediency. The California Bearing Ratio method of design was selected for flexible pavements. Design data were extrapolated from highway experience to provide for airplane loads. Westergaard's analysis was applied for rigid pavement design, based upon soils constants determined in the field. These methods were concurrently checked by employing "test tracks" throughout the country. The importance of airfield drainage was recognized, and necessary design criteria established. Longitudinal and transverse grade criteria to fit aircraft operational requirements, and yet provide adequate drainage, were also worked out.

Fig. 2. Greatest thickness of pavement is required in warm-up pads which are subjected to vibrations from the planes. Here an 11-in. thick slab is being placed.

Bombers brought to the field

By 1943, B-24 bombers, with rated gross loads of 74,000 lb., were operating at March Field, and engineering investigation and research had established design criteria for these so-called "heavy bombers." Additional pavements required for this operation included a 1,000 ft. extension to the East-West runway, a new taxiway and an addition to the parking apron. These pavements were 11-in. concrete on 8-in. compacted gravel base course on 6-in. minimum compacted native soil subgrade.

Early in 1945 operations at March Field were again increased. This time the Air Forces provided the "ultimate in airplane loads," the B-29 superfort, with a gross load of 120,000 lb. But the Engineer Corps designers had kept abreast of the times, and applicable design standards were available. A new Northwest-Southeast runway was first required and, since existing pavement and drainage facilities could not be abandoned, the new work had to be designed to fit the existing features and still meet design criteria for the heavy runway. The alignment was parallel to the existing Northwest-Southeast runway, and crossed both the existing North-South and East-West runways, not at grade, but at a considerably higher level, thus requiring pavement "conforms" to obviate sharp breaks in grade. Pavement was 7,000 ft. long and 150 ft. wide, with 75 ft. wide paved shoulders, plus 100 feet on either side composed of select granular fill treated with an asphalt penetrant, to provide dust and erosion control. Surface drainage had to be accomplished by means of a crowned cross section with 1.5 percent transverse slopes.

Drainage difficulties overcome

The centerline profile was established approximately parallel to the existing ground surface. In order to provide sufficient longitudinal grade in the shoulder drainage ditches and pipes, and still meet established drain outlet elevations and permit sufficient coverage of pipes crossing the runway, it was necessary to establish the elevation of the shoulder drains at approximately ground level. This provided a minimum 3 to 4 ft. fill at runway centerline. It was evident that cut and fill quantities could not

Fig. 3. Compacted subgrades are the key to successful airfield pavements. B-29 operation required 6 in. of dry-bound macadam on top of 18 in. of granular fill to permit a 4-in. asphaltic concrete surface.

be balanced within the cross section. However, a review of the CBR values of the subgrade soils indicated that a minimum cross section thickness of approximately 2½ ft. would be required to provide for the design loading. This cross section would be composed of imported granular material sub-base with a minimum CBR value of 40 percent, a select granular material base with a minimum CBR value of 80 percent and an asphaltic concrete surface course. Thus balancing of subgrade cut and fill quantities within the runway area was of secondary importance.

The next consideration was the selection of a surface pavement that was flexible enough to provide for possible unequal subgrade consolidation and yet provide sufficient shear strength to resist impact, locked wheel turns, breaking action, and vibration during takeoff of heavy airplanes. A 4-in. thick, crushed rock aggregate, open mix, asphaltic concrete was selected. The composition of the mixtures for the 2½-in. binder course and the 1½ in. wearing course is given in the accompanying table:

This asphaltic concrete was placed on a 6-in. dry-bound macadam base course placed in two equal layers, compacted by a self-propelled three-wheel, smooth roller weighing not less than ten tons. Rolling was continued until the stone was thoroughly keyed, and there was no creeping ahead of the roller. Choker stone was applied to each course by carefully spreading, brooming and rolling until no more could be forced into the voids. The following tabulation gives the gradation of the aggregates.

This dry-bound macadam base course was placed upon a carefully compacted imported granular fill having a minimum thickness of 1½ ft. A minimum CBR value of 10 percent was required. The specification gradation called for 100 percent (by weight) passing a 4-in. sieve, 65 to 100 percent passing a 1½-in. sieve, 30 to 65 percent passing a No. 4 sieve, 10 to 30 percent passing a No. 40 sieve and 0 to 10 percent passing No. 200 sieve. The maximum size in the top 6-in. was limited to 2-in. aggregate. Specifications called for compaction at optimum moisture content, which ranged from 5 to 8 percent, and produced optimum densities of 129 to 135 lb. per cu. ft.

AGGREGATE GRADATION FOR MACADAM BASE

Screen Size	Percentage by Weight Passing Square Sieves: Crushed Stone Aggregate	Choker Stone
3 in.	100	.....
2½ in.	90–100	.....
2 in.	35–70	.....
1½ in.	0–15	.....
¾ in.	0–5	.....
⅜ in.	.....	100
No. 4	.....	85–100
No. 100	.....	5–25

COMPOSITION OF MIXTURES FOR SURFACE COURSES

Screen Size	Percentage Passing Screens (Square Openings): 2½-in. Binder Course	1½-in. Wearing Course
1½ in.	100	.....
1 in.	70–90	100
¾ in.	52–75	84–100
⅜-in.	32–52	57–70
No. 4	22–36	40–50
No. 10	16–26	25–35
No. 40	7–13	13–22
No. 80	3–8	7–14
No. 200	1–4	3–5
Paving Asphalt	4.5–6.5	5–7

Tested for heavy loads

The imported granular material fill was placed in 6-in. layers and was compacted with an approved combination of sheepsfoot rollers and smooth rollers. After compaction the fill was tested with a 150,000-lb. rubber tired roller consisting of a tractor-drawn trailer with one pair of dual wheels, designed to simulate B-29 loading. The body of the trailer was weighted with pig iron which facilitated a variation of the wheel loads.

This heavy roller was also employed to test the compaction of the native soil subgrade, which was specified to be compacted for a minimum depth of 6-in. to 95 percent of optimum density. Thus weak spots in both native soil subgrade and the overlying imported granular fill could be discovered. When soft spots from insufficient rolling, or saturation by rainfall during construction, etc., were discovered, the material was removed and recompacted. This process resulted in rehandling of approximately 30,000 cu. yd. out of a total of approximately 425,000 cu. yd. of fill material, but it was considered that this was very necessary insurance for a major permanent airfield.

As soon as a portion of the runway was completed, an accelerated traffic loading test was made upon the asphaltic concrete pavement, employing the 150,000-lb. roller. This was accomplished by rolling back and forth on the same track, a distance of about 100 ft. along the centerline of the runway. Control points were established along this lane in order to measure any vertical or horizontal displacement. The test was made at a location where it was known that poor subgrade conditions had existed. However, after one hundred passes of

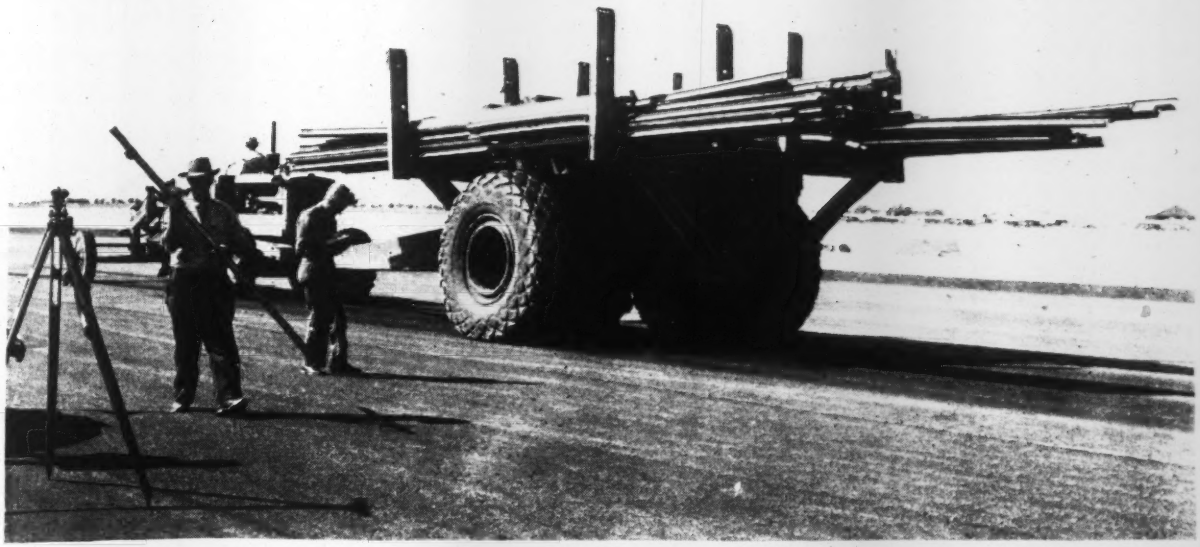


Fig. 4. Load-testing the runway with a 150,000-lb. dual-wheel trailer designed to simulate loads imposed by the B-29 planes.

the roller on this small area, which was deemed equivalent to several years of aircraft operation, the maximum vertical displacement measured only 0.2 in., with an average value of approximately 0.1 in. This roller test was supplemented by static load tests at other locations and at various depths in the runway cross section.

The final pavement consideration was the design of the 75-ft. wide taxiways. Loading requirements indicated that an 18-11-18 in. thick concrete slab on a 12-in. compacted select granular material base over a 6-in. minimum compacted native soil subgrade would be necessary. This design was based on a modulus of soils reaction of 150 lb. per sq. in. per in., a working strength of concrete of 350 psi. in flexure, and a wheel load of 75,000 lb.

Non-reinforced concrete was employed, and 1-in. round dowel bars 2 ft. long were spaced at 12-in. centers along the longitudinal construction joints and the transverse expansion joints. These dowels were installed across the longitudinal construction joints by drilling holes through the steel headers. The dowels were inserted into these holes and braced in position before pouring concrete. A paper sleeve on the dowel was employed to facilitate stripping the forms. It is believed that this type of joint will prove to be superior to formed shear keys for concrete pavement. These taxiways were widened to 150 ft. at the ends of the runways to provide warm-up pads. Elevations at the ends of the runways were established to provide for possible future lengthening and strengthening of the runways in anticipation of bigger airplanes to come.

This brings up to date the construction history of March Field Army Air Base. However, in conclusion, it is of interest to note that we now have at hand the airfield design criteria for airplane loads of 300,000 lb., and, that we have tried to anticipate the requirements of future heavy airplanes and to provide for them insofar as feasible in the current construction work at March Field.

Strict Anti-Smoke Laws Passed

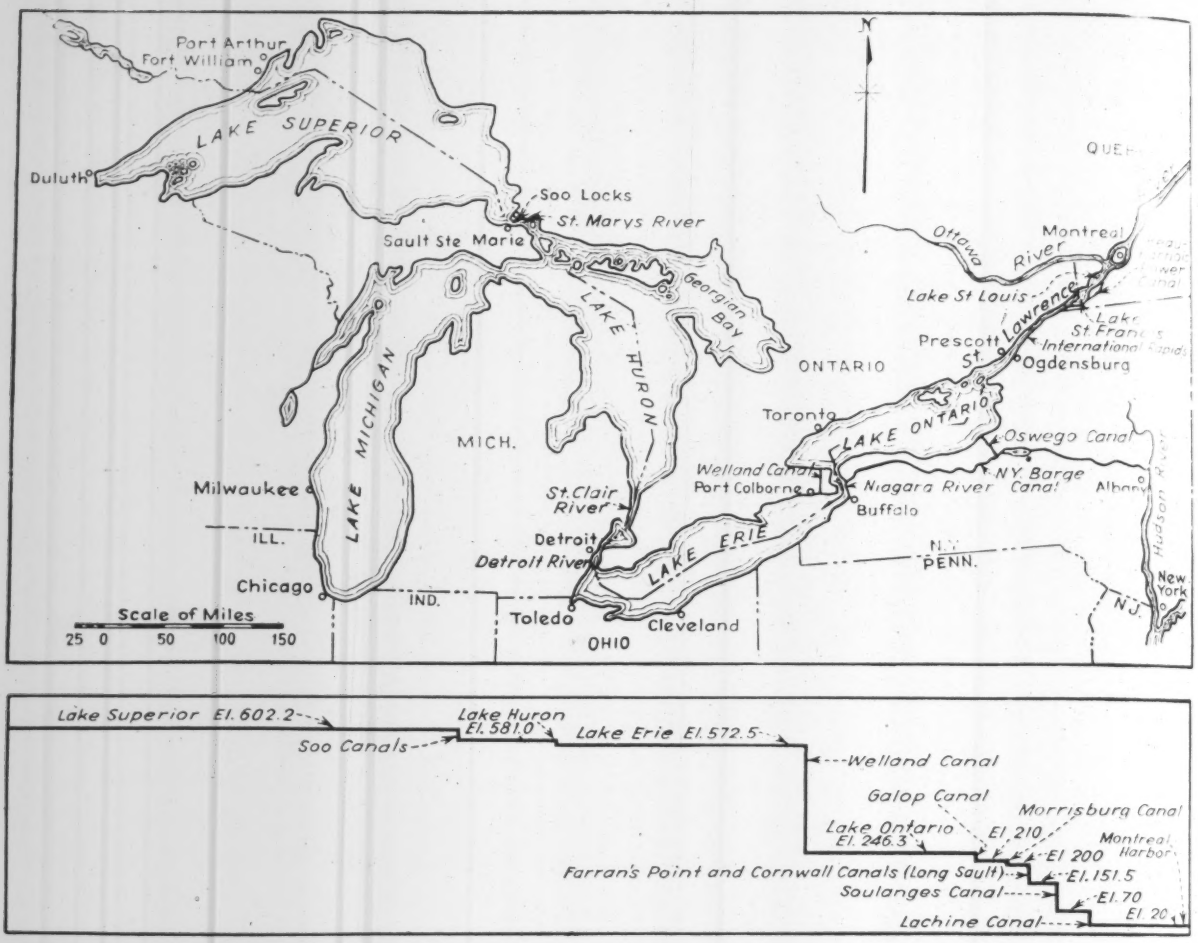
Two of the most exacting anti-smoke ordinances in the country were adopted recently in Niagara Falls, N. Y., and Providence, R. I., according to the American Municipal Association.

Both cities have established strong air pollution control agencies and have given them broad powers under a single ordinance to regulate smoke, dust, and fumes. In many cities, each polluting element is handled under a separate ordinance as a nuisance.

The Niagara Falls ordinance was based on a survey made by the New York State Labor Department's industrial hygiene division which disclosed that 30 industrial plants caused almost all dust, gas, fume, and odor emission in the vicinity. Electrochemical factories making abrasives and graphite were the principal offenders.

Providence's new pollution control ordinance creates a Division of Air Pollution Regulation, specifies strict legal limits on soot content of smoke, and provides for fines up to $100 for each day's violation of any section of the ordinance. Soot, dust, and poisonous content of smoke and fumes are comprehensively regulated and the new division is given broad powers to make additional regulations.

Inspection of construction, installation, and alteration of all fuel-burning equipment is provided for in detail by the Providence ordinance. The pollution control division is empowered to issue installation and operating permits for all fuel-burners except automotive internal combustion engines. Fuel-burners are sealed by the division to prevent tampering and are inspected annually.



Construction of a modern ship canal from Lake Ontario down to Montreal is called for under the joint resolution now before Congress, also the construction of a power plant of over 2,000,000 hp. capacity in the International Rapids.

St. Lawrence Estimates Revised

***Contents in Brief**—The cost to complete the St. Lawrence seaway and power project is now set at $674,707,000 by the Army Engineers, and the cost of new work chargeable to the United States in the International Rapids section of the river is put at $414,840,000. The Commerce Department foresees sufficient traffic to make the ship canal self-liquidating. Large imports of iron ore are considered probable in the future.*

ESTIMATES of the cost of completing the St. Lawrence power and seaway project have been increased about 65 percent over the 1941 figures. Revised figures were given by Lieut. Gen. Raymond A. Wheeler, Chief of Engineers, U. S. Army, on June 13 in testimony before a subcommittee of the Senate Foreign Relations Committee that was then holding hearings on a joint resolution now before Congress approving the agreement between the United States and Canada authorizing construction of the St. Lawrence project that was signed in 1941 but never ratified by Congress. General Wheeler now sets the cost of completing the project at $674,707,000, as compared to the 1941 estimate of $409,340,900.

Details of the Army Engineers figures are given in the accompanying table. The cost of work in the International Rapids section of the river, which is the subject of the joint resolution now before Congress, is placed at $513,884,000, of which $414,840,000 would have to be provided by the United States to equalize the large investment already made by Canada in the Welland Canal and yet to be made by Canada between Lake St. Francis and Montreal.

The 1941 agreement

The 1941 agreement provided for the development about 2,000,000 hp. of power in the International Rapids section of the St. Lawrence River and

for construction of a 27-ft. ship canal from Lake Ontario down to tidewater at Montreal to replace the present 14-ft. channel, also for the construction of certain remedial works above Niagara Falls to redistribute the flow there. (*ENR*, May 22, 1941, vol. p. 824). Although that agreement was not ratified by Congress, the remedial work was carried out subsequently at Niagara and a new lock was built at Sault Ste. Marie as a war measure, the cost of which was included in the estimates of the entire project made in 1941. The new estimates give the actual cost of MacArthur Lock at the Soo as $14,637,000 instead of the 1941 estimate of $8,000,000, the increase being due to the war conditions under which it was built. No cost figures for the Niagara work were given.

Cost estimates revised

In explaining how the revised estimates were made, General Wheeler said, "The estimates as now submitted are based upon the May, 1947, Construction Cost Index published by the *Engineering News-Record*. . . . The previously submitted estimate was based on prewar figures, namely, the cost of work primarily for power was based on 1939 cost levels and the balance of the estimate was based on 1941 levels. The *Engineering News-Record* Construction Cost Index for May, 1947, is 68.4 percent higher than the 1939 average and 53.8 percent higher than the 1941 average. By applying these increased factors, the cost estimate as of May, 1947, shown in the foregoing schedule, results.

The Army Engineers' revised estimates appear to be inconsistent in that while a factor representing the increase of 1947 costs over 1941 or 1939 costs is applied to work in the International Rapids, no such factor was applied to the cost of work in the Canadian section. The figures given in the Army Engineers' tabulation are the estimates made by the Canadian engineers in 1941. If the percent of increase shown by the *ENR* cost index is applied to the 1941 estimates for the Canadian work, they will be raised from $82,954,000 to $127,583,000, and the total for the entire undertaking would have to be raised from $674,707,000 to $717,336,000.

Cost to New York State

Under an agreement made in 1941 between the federal government and the state of New York, it was determined that New York was to pay for the power house on the United States side in the International Rapids section and for the machinery and equipment in that side of the power house, together with one-fourth of the cost of work common to navigation and power chargeable to the United States in the International Rapids section. In return, the state was to receive the power developed on this side of the border. Under the 1941 estimates, the costs were expected to amount to $93,000,000; under the 1947 estimates, New York's share is raised to $161,000,000.

The Chief of Engineers placed the construction period at six years and estimated the annual carrying charge for navigation alone chargeable to the United States, including the cost of maintenance and operation, at $12,230,000.

General Wheeler stated that the Corps of Engineers had made no study of potential traffic, but taking the figure of $18,000,000 as the annual benefit arrived at in a study entitled "Potential Traffic on the St. Lawrence" prepared by the U. S. Department of Commerce in 1941, he concluded that the ratio of cost to benefits would be 1.00 to 1.46.

Anticipated traffic

Estimates of potential traffic using the seaway that were characterized as "very rough" were presented to the Senate subcommittee by W. A. Harriman, Secretary of Commerce. Mr. Harriman had been asked by the committee to report both on potential traffic and on the probability of making the project self-liquidating by charging tolls, as called for in the joint resolution now before Congress for approval. Mr. Harriman said that his estimates of income from tolls were based on charging $1.25 per ton for general merchandise traffic, the maximum amount in the joint resolution, but that he was using a much lower figure, somewhere between 25 and 50 cents a ton, for bulk traffic.

The Great Lakes area, Mr. Harriman said, embraces about one-third of the country's population, produces about 40 percent of its manufactured products, contains about 80 percent of its steel-ingot capacity, and manufactures about three-fourths of its motor vehicles. He considers it a reasonable assumption to conclude that this area will utilize the seaway for general merchandise traffic to the extent of at least 10 percent of the total United States foreign trade. This general merchandise traffic, when world trade conditions approach normal, is estimated by the Department of Commerce at 40,000,000 tons, hence the 4,000,000 tons that would move through the seaway would represent $5,000,000 in tolls.

Mr. Harriman believes further that

ESTIMATE OF COST OF SEAWAY AND POWER PROJECT

	Canada	U. S.	Total
Great Lakes Section:			
New Lock at Sault Ste. Marie with Approach Channels	.....	$14,637,000*	$14,637,000
Connecting Channels	.....	92,591,000	92,591,000
Welland Canal	$133,000,000	.....	133,000,000
St. Lawrence River:			
Thousand Island Section	772,000	1,283,000	2,055,000
International Rapids Section:			
A. Works solely for Navigation	.....	66,079,000	66,079,000
B. Works primarily for Power	64,571,000	166,184,000	230,755,000
C. Works common to Navigation and Power	34,473,000	182,577,000	217,050,000
Canadian Section:			
St. Francis Lake Channel	1,330,000*	.....	1,330,000*
Soulanges Reach	25,785,000*	.....	25,785,000*
Lachine Reach	55,839,000*	.....	55,839,000*
Total	$315,770,000	$523,351,000	$839,121,000
Expenditures to date	132,672,000	31,742,000	164,414,000
Cost to complete	$183,098,000	$491,609,000	$674,707,000

*Canadian estimates prepared in 1941.

the Canadian general merchandise traffic from overseas and domestic water-borne traffic in the general merchandise class would add 2,000,000 tons. He stated further that the general merchandise traffic might reach or exceed 10,000,000 tons, providing $12,500,000 in tolls.

Movement of bulk commodities

Turning to the question of the anticipated movement of bulk commodities through the seaway, Mr. Harriman said that it is essential to view this subject from the standpoint of future as well as present needs. Some authorities, he said, maintain that the high-grade iron ore deposits of the upper Great Lakes area will be exhausted within 20 years, which would mean that in the very near future this country must import large quantities of foreign ores. The natural route to the steel producing area for this foreign ore, he said, would be through the seaway, especially if this ore came from the high-grade deposits of Labrador.

Mr. Harriman said that the Commerce Department, while not predicting that such an ore movement will develop, estimates that it might amount to 20,000,000 or 30,000,000 tons in the foreseeable future.

A second long-range movement that Mr. Harriman mentioned as a possibility is a great movement of petroleum from overseas sources, particularly from the Persian Gulf region. At present about 1,000,000 tons of petroleum and its products move over the existing 14-ft. channel.

Early traffic gains expected

Important traffic developments that would immediately follow completion of the seaway, Mr. Harriman said, would be a substantial gain in volume of the movement of wood pulp, pulpwood, some petroleum, down-bound U. S. coal, and possibly some other bulk commodities. The grain movement, he put at 5,000,000 tons, and coal at possibly 4,000,000 tons.

In summary, Mr. Harriman said: "Bulk traffic on the seaway is likely to develop from the low figure of about 12,000,000 tons to a maximum of between 30,000,000 and 40,000,000 tons. With tolls at the ranges previously indicated, the lower traffic figure would result in tolls from $3,000,000 to $6,000,000, and the higher figure would produce toll fees of from $10,000,000 to $20,000,000. Ballast traffic would provide another $2,000,000 or $3,000,000. Including general merchandise, toll revenues on the seaway would appear to be at least $10,000,000 shortly after completion of the project. With the development of either iron ore or petroleum traffic and some increase in general merchandise traffic, toll revenues might rise to $20,000,000 or $30,000,000."

Shop-Built Tools Speed Road Test Work

THREE special shop-built tools are being used by the division of tests of the Virginia Department of Highways to speed up both laboratory and field work. A new type tool known as a porosimeter has been built to test the porosity of macadam and bituminous surfaced pavements. Preparation of soil samples for various tests is simplified by use of a special pulverizer, and a constant-temperature cabinet has been equipped at little cost for study of membrane curing compounds.

The porosimeter is illustrated by Fig. 1. It was built of brass about five years ago in the shops of the division of tests and has proven accurate and easy to use. The pavement area covered is exactly 1 sq. ft., the inside diameter of the circular plate being slightly under 14 in. A space with a volume of about one quart is provided between the top of the pavement and the under surface of the plate, which is sloped slightly upward toward the center to prevent air being entrapped. To provide a seal between the pavement and the roadway a sealing compound made up of cup grease and limestone dust is used.

Water is added below the plate with a flexible hose from a 2-gal. sprinkling can until the level of the water is a little above the beveled indicating edge. Water is then drawn off with a rubber bulb pipette until the beveled edge just breaks the surface. The stop watch is started and water added from a graduate, at the same rate as it is being lost into the road, or at a rate just sufficient to keep the water level up to the indicator edge.

Watertepidness tested

In using the porosimeter, the usual procedure is to determine the amount of water that passes into the 1 sq. ft. of pavement in a 10-min. period. Tests are generally made in the fall for each mile of sand-asphalt pavement put down that construction season. The measurements, when compared to previous tests, aid in evaluating the water-tightness of the new pavements. Ordinarily, tests are spaced about one mile apart along the highway, but if an open pavement is indicated much more frequent readings may be taken. Where pavements have been found a bit too porous similar tests are made the next year to

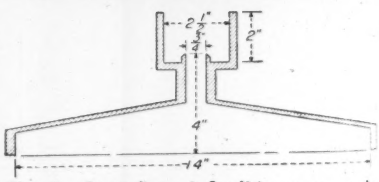


Fig. 1. Porosity of flexible pavements is evaluated by use of porosimeter to measure the amount of water penetrating 1 sq. ft. of the pavement in a given period, usually 10 minutes. Details of the porosimeter are given in the cross-section.

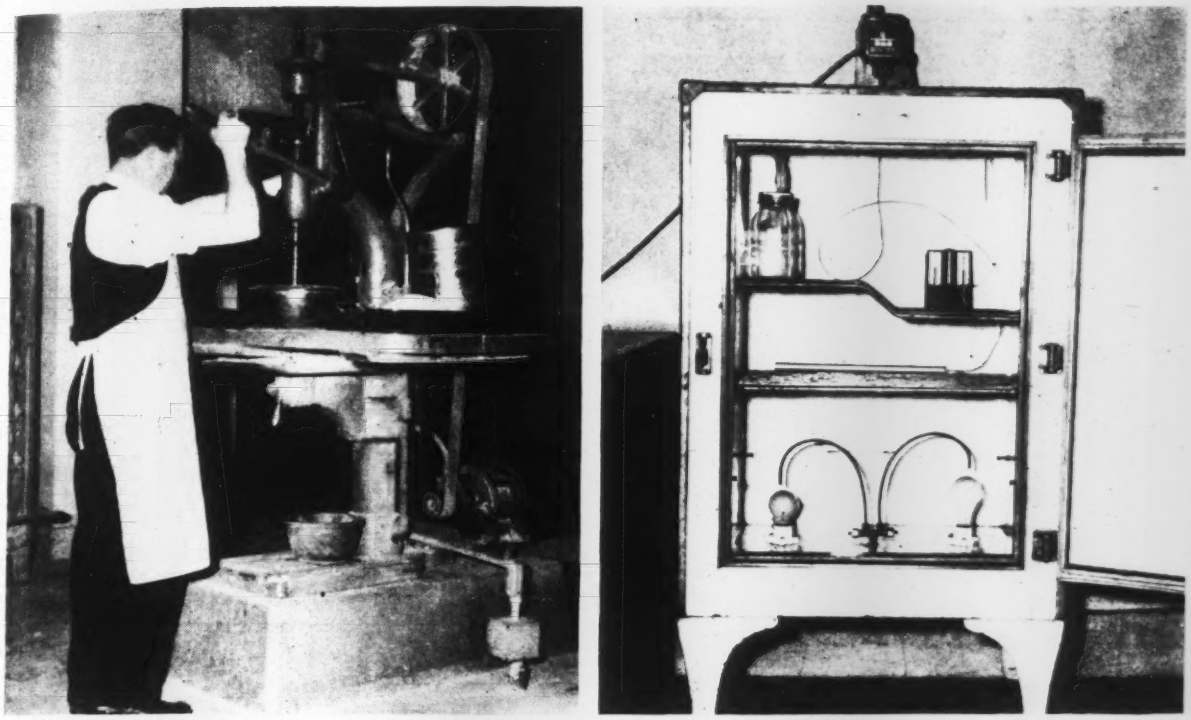


Fig. 2. To eliminate many hours of hand labor in pulverizing soil test samples, an old core drill rig (left) was equipped with a rubber muller and a heavy mortar was build for quick installation below the wheel. For study of curing compounds for concrete pavements, an old freezing cabinet (right) was equipped with constant-temperature controls.

see if the surface has closed up under traffic.

The soil pulverizer has been used since 1938 to prepare soil samples varying from gravelly soils to fine grained soils for density, mechanical and hydrometer analysis, and Atterburg limit tests. It consists of an old coreboring drill that has been modified for laboratory use by addition of a pulverizer wheel, made of rubber, on the end of the drill shaft (Fig. 2).

The soil to be pulverized is placed in a heavy cast iron mortar held down by a bottom plate sliding beneath two plates attached to the top of the table. A lid equipped with a rubber flange closes the top of the mortar once it is in place.

Generally, 3 to 5 lb. of material is placed in the mortar. Length of the pulverizing operation depends upon the type of sample, but it is many times faster than hand methods. A 25-lb. sample of sandy soil may be pulverized in approximately 5 min., whereas a heavy clay may take 25 min. The life of the pulverizing wheel is sufficient that many samples can be prepared before the wheel needs to be replaced. An average life is about one month.

Testing curing compounds

The curing cabinet (Fig. 2) is used by the department for the testing of liquid membrane curing compounds for concrete. It was designed by laboratory personnel and consists of an old electric freezing cabinet equipped with a thermostatic control that keeps the temperature within 1 deg., plus or minus, of 100 deg. F.

The heat is supplied by two electric light bulbs—a 25-watt that burns continuously and a 100-watt bulb that is controlled by the thermostat. These bulbs were installed in the bottom with a T-control valve and two tubes to allow a small flow of air over each bulb.

Several small openings were made in the top of the cabinet to increase circulation. They also permit installation of the dry- and wet-bulb thermometers.

The relative humidity is maintained fairly constant between 33 and 39. To hold the humidity below 33 on humid days a container of calcium chloride is placed in the cabinet so that the air coming into the cabinet blows over the calcium chloride and is dehydrated.

Shreve Clark is testing engineer for the Virginia Department of Highways. The cabinet was equipped under the direction of D. D. Woodson, and R. G. Bremner developed the porosimeter. The soil pulverizer was equipped under the direction of C. S. Phillips from information supplied by A. E. Stoddard, assistant testing engineer of the Iowa State Highway Department.

New High in License Applications

A total of over 1,000 candidates are scheduled to take the June examinations of the New York State Board of Examiners for Professional Engineers, which is a new high record for that board, according to D. B. Steinman, chairman. The largest previous examination was in June, 1936, with 942 candidates. In recent years the number has been around 400 or 500 for the semi-annual examinations in June and February.

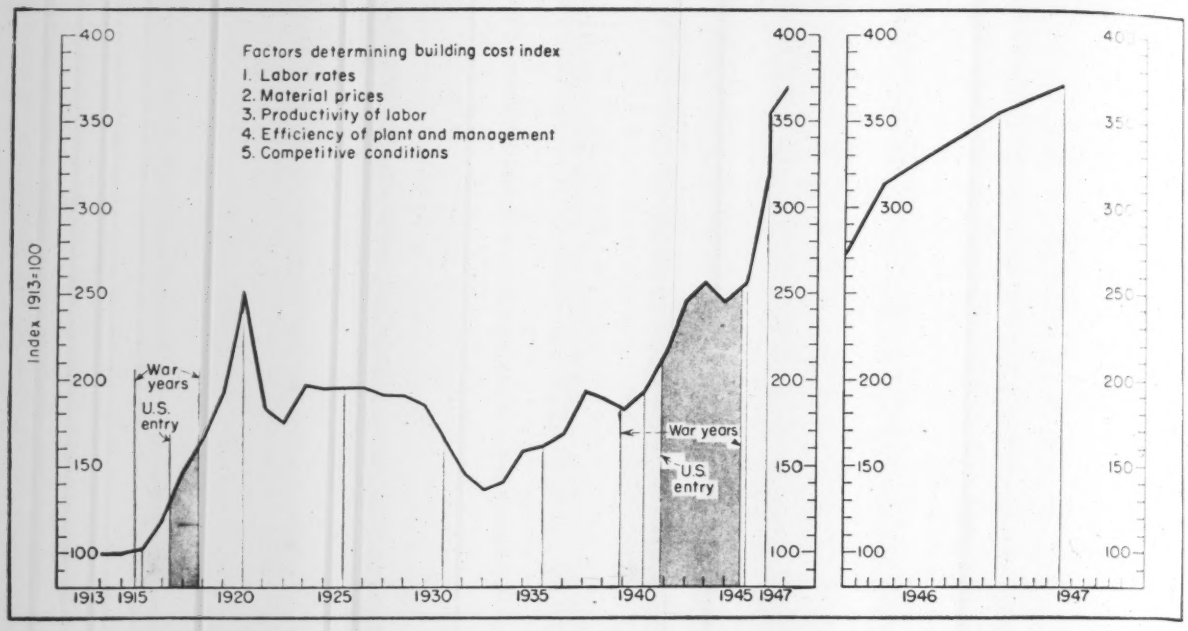


Fig. 1. Some leveling off of building costs is indicated by the index prepared by the Turner Construction Co.

Construction Costs to Continue High

Harry A. Ward
Vice President, Turner Construction Co., New York.

***Editor's Note**—Much new construction has been postponed in recent months in the mistaken belief that construction costs will decline in the near future, a belief that has been fostered by forecasts made by men not intimately familiar with all the factors that affect construction cost trends. In the following statement Harry A. Ward sets forth his reasons for concluding that such costs will continue at or near the current levels. His position as head of the division of the Turner Construction Co. that prepares the company's cost estimates and compiles its index of building costs makes it possible for Mr. Ward to speak with authority on this subject.*

DURING the past few months there have been published many forecasts of the future trend of building costs. The range of these predictions would indicate a decline of from 20 to 30 percent. Some even suggest the return to a cost level of from 30 to 50 percent above the 1939 base.

I am at a loss to account for the basis of such optimistic predictions and feel that it is harmful to the country as a whole to issue information such as this which cannot help but retard the bringing out of new construction work. If building construction is curtailed for too long a period, contractors and material producers will be forced to reduce their staffs and their rate of production. The backlog of needed construction will be increased and when the time comes that a large volume of work is released, it will place a burden on both the builder and the producer of materials. This may create a condition similar to that experienced in 1920—a condition which we had all hoped we would escape after World War II.

While it is true that construction costs are greatly in excess over those prevailing in 1939, the increase has not been as great as has prevailed in many of the items entering into our every-day life, nor have the on-site building wages increased in as great a proportion as factory wages.

There is no question that we have been experiencing for some time resistance of owners to proceed with new projects at the present price level. A buyer's strike does not last indefinitely. Just as we become reconciled to paying more for clothing, food and luxuries so will we ultimately become used to paying the higher costs of construction. Part of the resistance to purchasing emanates from the encouragement that has been given to prospective owners that there will be a great drop in construction costs.

Let us analyze for the moment some of the factors entering into building costs:

The fees received by contractors

are exceedingly low, averaging less than 6 percent of the cost of the work on large contracts from which must be subtracted the contractor's office overhead, which may run anywhere from 3 to 5 percent. It can be readily seen therefore that we cannot expect savings from a reduction in fees. They have already been forced to a very low rate by the low scales in existence during the war where a tremendous volume of work enabled the contractors to operate under these fees and still exist.

Labor costs

It is generally conceded that wage rates will not come down nor can we expect to restore to lower paid branches of labor certain work that has been taken over by the craftsmen at higher wage rates nor can we eliminate the additional cost that has crept into the picture recently of paid holidays which amounts to 3 to 4 percent of the payroll.

The differential between factory wages and on-site building wages is not as great today as was the case before the war, resulting in fewer men choosing to work in construction. Curtailment of immigration during the past years eliminated one source of supply of construction labor. While we may hope to secure somewhat better efficiency due to working conditions, it will probably be some years before we can bring new workers into the industry in quantity and train them to the degree of skill displayed by the pre-war craftsman.

Due to cramped living conditions it is more difficult to move labor from one section of the country to another. The construction worker has ceased to be a floater and prefers to remain in a fixed position. A reduction in cost of construction due to an increase in efficiency might result should we have a severe depression and stagnation of the industry but such saving would not be permanent.

We do expect greater efficiency in the operation of the job which may help to offset the increase in cost that is being brought about today because wages are still being increased.

Construction materials

There has been an indication in recent weeks of a softening in the material market on certain items such as lumber. Should the demand decrease rapidly we will see a further reduction but we cannot expect that building commodities will be reduced in as great a proportion as the general run of commodities. There are still shortages in many of our materials such as lead, copper, tin and sheet steel. If we examine the change in the commodity wholesale prices between April, 1939, and April, 1947, we find a far lower amount of increase in building materials than in such items as corn, cotton, hogs, wheat and cattle.

Misleading price figures

Some of the forecasts have been predicated on a study of these published wholesale prices and have been exaggerated by comparing a present-day wholesale price with a published wholesale price of an earlier period. This latter price was correct as a published price but there was no such commodity available in that grade or quality at that time, primarily because it could not be manufactured and sold for such a figure. Other predictions assume that there will be a reduction in cost by eliminating escalator clauses. Practically all construction work has been executed under contracts based on present-day conditions and prices.

By the very definition of "escalator clause" we would first have to add the increase to the present-day construction cost before making that saving.

Less than a year ago we were struggling to secure materials such as brick, tile, cast-iron pipe, etc. where shortages occurred generally because the price that they could be sold for was not high enough to induce a producer to supply the needs of the industry. Since that time there have been increases in factory wages and we are now engaging in another round of increases. It is, therefore, improbable that building material prices will be reduced to any great extent except for brief periods of distress selling in certain fields where there may have been over-stocking.

Evidence of stabilization

Our first aim is to stop the further increase of building costs. It is my opinion that we have about reached the peak. We then should endeavor to stabilize on a basis that will permit the fabrication of materials and their erection in the field under circumstances that will yield a reasonable profit to the builder. We might hope to overcome the increased cost due to the present round of wage increases both in the factory and in the field by slightly lower material prices, an increase in labor efficiency and a lessening of strikes. We would expect therefore to stabilize at costs as of Jan. 1, 1947, with the further thought that there is always a fluctuation in such costs that might run 5 percent in either direction from such a level.

In support of this assumption for stabilization we have compared the reaction after World War I with what has been taking place recently and what we might expect in the future. Referring to the Turner Construction Company Building Cost Index (see Fig. 1, we find that building costs for the years 1921 to 1929, inclusive, were 89.2 percent above the level existing before World War I started. In the nine years of the 1920 era there were no wide variations. The year 1921 was not included in this group as it was abnormal.

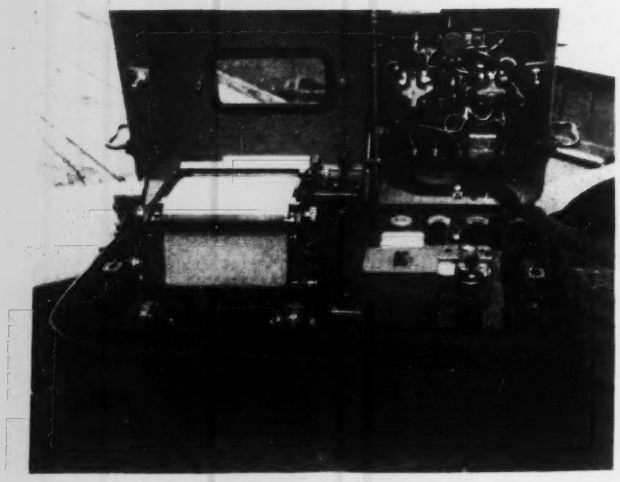
Postwar trends compared

At the depths of the greatest depression that has been experienced in our time the index dropped in 1932 to a low, 28 percent below this average but still 36 percent above pre-World War I. It returned to an average of 133 for the three years 1937 to 1939, inclusive, an indication that this was very close to a normal base.

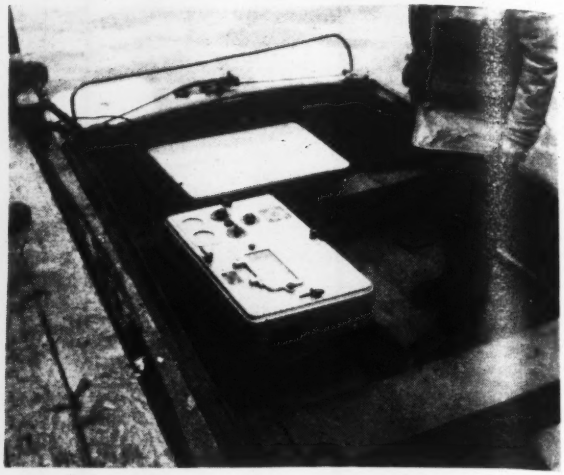
If we apply the same percentage of increase that occurred after World War I to 188, we would have an index of 356, approximately where our index stood as of last December.

In consideration of these figures taken with the fact that World War II was of longer duration than World War I and that the world-wide destruction was far greater, it is reasonable to assume that a normal index figure for construction in the period ahead should be about 356, a figure close to the index as of Jan. 1, 1947.

With construction continuing at or near its present volume for the remainder of the year and with improved production of construction materials, we might see a slight decrease in construction costs, after which the demand will again increase and costs will rise moderately, continuing at a new high level.



A portable echo sounding recorder is now being tested by the Corps of Engineers' Buffalo District.



Inclosed in a watertight case, the recorder is used in a motorboat equipped to control speed accurately.

Portable Echo-Sounding Recorder Speeds Hydrographic Surveys

***Contents in Brief**—If an echo-sounding recorder, now being tested by the Buffalo District, Corps of Engineers, proves successful, not only will the work of making hydrographic surveys be greatly speeded up but also costs will be reduced. This device consists of a portable depth recorder and an outboard oscillator suspended from the side of a motor launch. Power is supplied by a 12 v. storage battery charged by a generator on the boat's engine.*

A PORTABLE echo-sounding recorder for making hydrographic surveys is being tested in connection with maintenance dredging in the harbors of the Corps of Engineers' Buffalo District. The complete unit consists of a portable depth recorder which contains a recording mechanism, operating controls, and an outboard oscillator which contains a magneto-striction type transmitting and receiving unit. The equipment has been designed especially to record, automatically, relatively shallow depths of water with a high degree of accuracy. The equipment is rugged, light in weight, compact, simple to operate, and requires minimum maintenance.

Depths of water from 3 to 180 ft. are recorded permanently in three ranges (0 to 60, 60 to 120, and 120 to 180 ft.) at the rate of 300 soundings per min. so that abrupt changes in depths of water are readily observed. The equipment operates automatically when the power switch is turned on, the only attention required being selection of depth range on the recorder and an occasional simple check of the battery voltage. Total power required is 12 v., d.c., at 14 amp., or 168 watts, which is supplied by a separate 12-v. storage battery charged from a generator attached to the boat's engine.

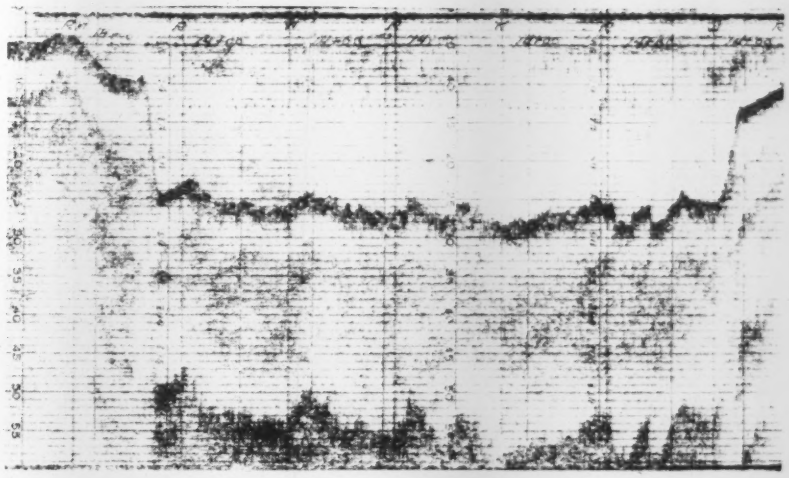
Depth measured by sound wave speed

Depth recordings are dependent upon precision timing of the velocity of sound pressure waves in water. A series of electrical impulses, at a frequency of approximately 14 kc., are released by the closure of synchronized contacts in the recorder and are conducted to the transmitting oscillator. These electrical impulses are there converted to a series of sound pressure waves which are projected to the channel bottom at a velocity of approximately 4,800 fps. They are reflected back to the receiving oscillator, there converted to electronic impulses which pass through a high-gain amplifier and recorded on the calibrated chart in the recorder by the arc-discharge method. The instrument measures accurately the elapsed time between the transmission and reception of an impulse and translates this time interval directly into depths of water in feet for direct reading on the calibrated recording-chart paper employed.

The portable depth recorder is inclosed in a watertight case which is approximately 14 in. high, 19 in. wide and 32 in. long, and weighs 110 lb. The outboard oscillator in a streamlined aluminum housing is about 12 in. high, 14 in. wide, and 36 in. long, and weighs about 145 lb. It is suspended over the side of an 18-ft., inboard motorboat by means of pipe standards and a simple supporting framework bolted across the gunwales. The handling of the oscillator is facilitated by means of a small davit mounted in the boat.

The depth curve recorded on the chart paper appears as a continuous graph representing the contour of the channel bottom. The depth scale on the chart paper is divided into ap-

Sound waves are sent and received by recorder-connected floating oscillator.



In one of the test runs, this section across Lorain Harbor, Ohio, was plotted by the echo sounding recorder operating from a motorboat.

proximately 10 parts to the inch, with each division representing 1 ft. The other scale on the chart paper, which represents time, is variable depending upon the speed of the boat carrying the equipment.

Furthermore, the chart paper travels over a series of rollers at a uniform rate of 1 in. per min., and therefore, by running the boat at a uniform rate of speed and with a minimum of position locations a definite distance scale can be affixed to the chart. A practical scale for distance depending upon the degree of detail desired, is obtained by choosing the proper running speed for the boat.

Plotting time cut by better technique

The transposition of the graph on the chart, to figures representing depths of water on the finished sounding map by methods comparable to those used in plotting the figures obtained by the sounding line method entails more work in the drafting room. However, by improved drafting room technique the additional time required for plotting is reduced.

The results obtained during the first weeks of operation indicate that the time required to perform the field work by this method may be reduced to fifty percent of the time required for the former lead-line method with a considerable net saving in costs.

The recorder being tested is Temporary Model ES-123 Portable Depth Recorder manufactured by Bludworth Marine Division of National-Simplex-Bludworth, Inc., New York, N. Y.

Parking Meters Get Revenue

To regulate parking and boost revenues many cities are installing meters according to the Municipal Finance Officers Association.

In the "Supplement To Where Cities Get Their Money," (*Where Cities Get Their Money*, Hillhouse and Magelssen, 1946) the association reports 451 cities installed parking meters last year, setting an all-time record and boosting to 924 the number of cities with metered parking.

Average annual collections per meter increased last year from an estimated $80 to approximately $100, mostly because of removal of wartime driving restrictions and manufacture of new autos.

Some 300,000 meters were sold in 1946, of which 190,000 were delivered for installation during the calendar year. Hundreds of small cities installed parking meters last year for the first time. Thirty-eight cities over 25,000 installed their first parking meters in 1946.

In cities where meters are used most extensively their collections account for a sizeable portion of municipal revenue. San Diego's 2,422 meters collected $279,000; in Denver 3,029 meters collected $269,000 while Seattle's 1,799 meters collected $190,000 and Dallas' 1,500 meters yielded $190,000. Meter revenues are secondary to traffic control however, the Association observes.

Of the 14 U. S. cities over 500,000 population, Buffalo, Pittsburgh, Cleveland, and Washington have parking meters. All four installed more meters last year. Vehicular Parking, Ltd.—an organization that publishes data on the use of parking meters—reports that other big cities using meters include Minneapolis, Kansas City, Newark, Providence, Houston, Portland, Ore., Oklahoma City, Dayton, Rochester, N. Y., and Wichita.

Among smaller communities, 177 cities under 5,000 population now operate parking meters, while 222 cities between 5,000 and 10,000 and 288 cities between 10,000 and 25,000 have installed parking meters. Smallest municipality so far to install parking meters is McConnellsburg, Pa., population 1,055, where 60 meters collected an average of $36.50 each during the last year.

Meters in most cities take both pennies and nickels. However in Canastota, Oneida, Oswego, and Syracuse, N. Y., and New Britain, Conn., parking meters take only pennies.

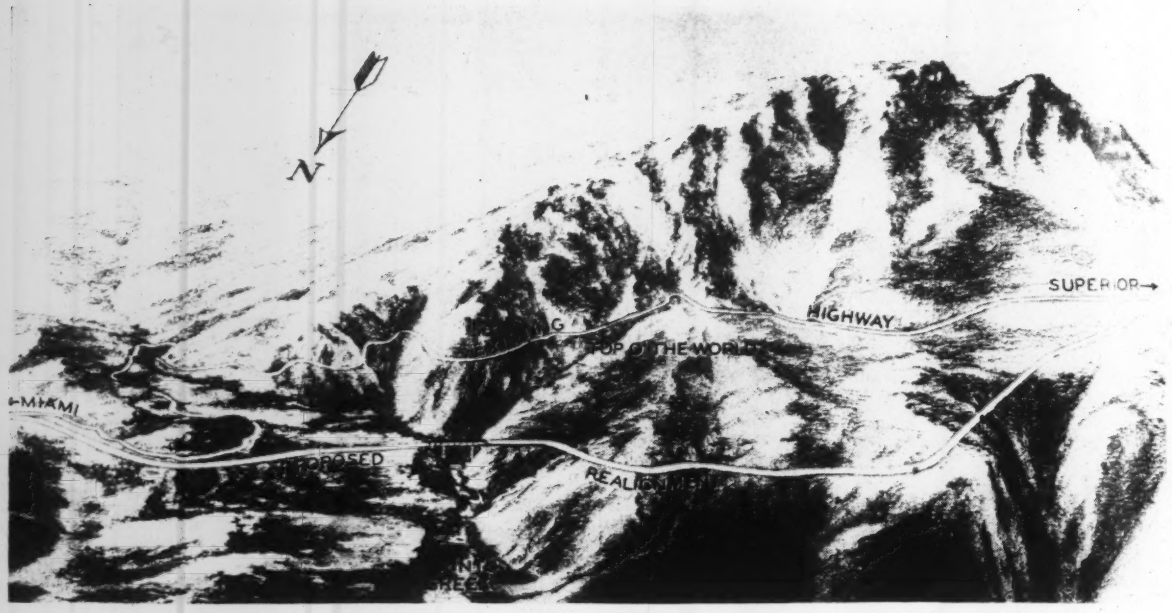


Fig. 1. Proposed realignment of the Superior-Miami Highway in the vicinity of Pinto Creek. This artist's sketch indicates the character of the country more clearly than a map.

Arizona Relocates a Mountain Highway

***Contents in Brief**—The highway relocation at Pinto Creek between Superior and Miami, Ariz., a vital link in the rehabilitation of Arizona highways, serves as an example of the difficulties encountered in design and construction of mountainous sections of cross-country routes. Some 61 curves were eliminated in 4 miles of roadway. Grading and paving on the 3.3-mile contract will cost more than half a million dollars and a 350-ft. clear span steel arch bridge is comtemplated.*

SOME 61 CURVES in a 4½-mile section of tortuous mountain highway are being eliminated by 3.3 miles of new construction on U. S. Route 60 between Miami and Superior, Ariz. This work will also provide flatter grades and a wider two-lane roadway. Although the average traffic count is only 1,500 vehicles per day, much delay is encountered on this major cross-state route (U. S. Routes 60 and 70) because a large percentage of the traffic is heavy trucking which is slow on the steep grades and difficult to pass due to the curves. Wintertime ice adds further hazard to the existing location.

The existing route, which connects two key cities in the copper mining section of Arizona, has been in service for more than 25 years with but minor repairs. Other parts of the road have been improved and modernized, but the Pinto Creek section was postponed until the last because of its difficulty and cost. The new location saves more than a mile in cutting the distance down to 3.3 miles and eliminates 61 curves, some five or six of which were complete horseshoe turns. Curves on the new alignment are limited to a maximum of 6 deg. and the grade is limited to 6 percent. Transition spirals from tangents to horizontal curves further make driving easier.

Road surface on the old route was only 20 ft. wide and individual traffic lanes were but 9 ft. wide. This narrow width combined with steep grades and many curves made passing almost impossible.

The newly located road will still have only two lanes but will have a minimum width of 40 ft. in both cut and fill. This width provides for two 12-ft. traffic lanes with 8-ft. shoulders on each side. Such extra width will make it easier for motorists to take advantage of increased sight distance and flatter grades to pass trucks and slower cars when necessary.

Terrain makes access a problem

Access to the new location was a problem in both layout and construction of the new route. Survey parties, although traveling less than a mile from the old road, used pack mules to carry their equipment. Construction forces first built pilot roads so that equipment could be well distributed over the job for efficient operation.

The deep canyon of Pinto Creek in the center of the job divides the work into, what amounts to, two separate projects. This canyon will be spanned at a later date by a steel arch bridge to be constructed under a separate contract. Calling for bids on the bridge job was delayed due to steel shortages in 1946 and so that the completed road relocation would provide easier access to the bridge site. The bridge will be a solid rib steel

Fig. 2. The Pinto Creek relocation traverses the mountainous terrain here shown. The dotted line indicates the route of the new highway.

arch with a rib depth of some 7½ ft. and will have a clear span of 350 ft. The arch will rise some 72 ft. and the roadway will be 150 ft. above the floor of the canyon. Further complicating the design is the fact that the bridge lies on a vertical curve and on a transition spiral.

During final tests for the bridge pier foundations, an abandoned mine tunnel was found some 25 ft. underneath one of the piers. This tunnel was only about 5 ft. in diameter, but the relocation of the end of the bridge by a few feet was necessary to assure adequate foundation.

Contract for more than half a million

Contract cost for the 3.3 miles of new roadway will run more than half a million dollars, without including the bridge crossing of Pinto Creek. Original bid price was $496,568, but changes are expected to run this amount to just under $520,000. The contract includes grading, drainage, base course of aggregate and road mix bituminous surface with seal coat.

Excavation amounts to some 396,000 cu. yd. and is practically all in granite. Some cuts are as much as 100 ft. deep at the center line and 160 ft. on the upper side and they required blasting for their full depth.

Fills on 1½ to 1 slopes ranged up to 226 ft. in height. Filling in layers for best compaction was impossible on many fills. Instead, end-dumping by trucks was necessary with layering done by bulldozer equipped tractors where possible. However, because most of the fill is hard rock, not too much settlement is expected.

The road contract is now practically completed. However, as the bridge will not be completed for some time, the exact date of opening this new route has not yet been determined. It is hoped that it will be open to traffic by January of 1948.

Design and construction of this route are under the direction of W. C. Lefebvre, state highway engineer, and problems on the location were worked out by E. V. Miller, engineer of plans and surveys, and N. G. Wallace, lo-

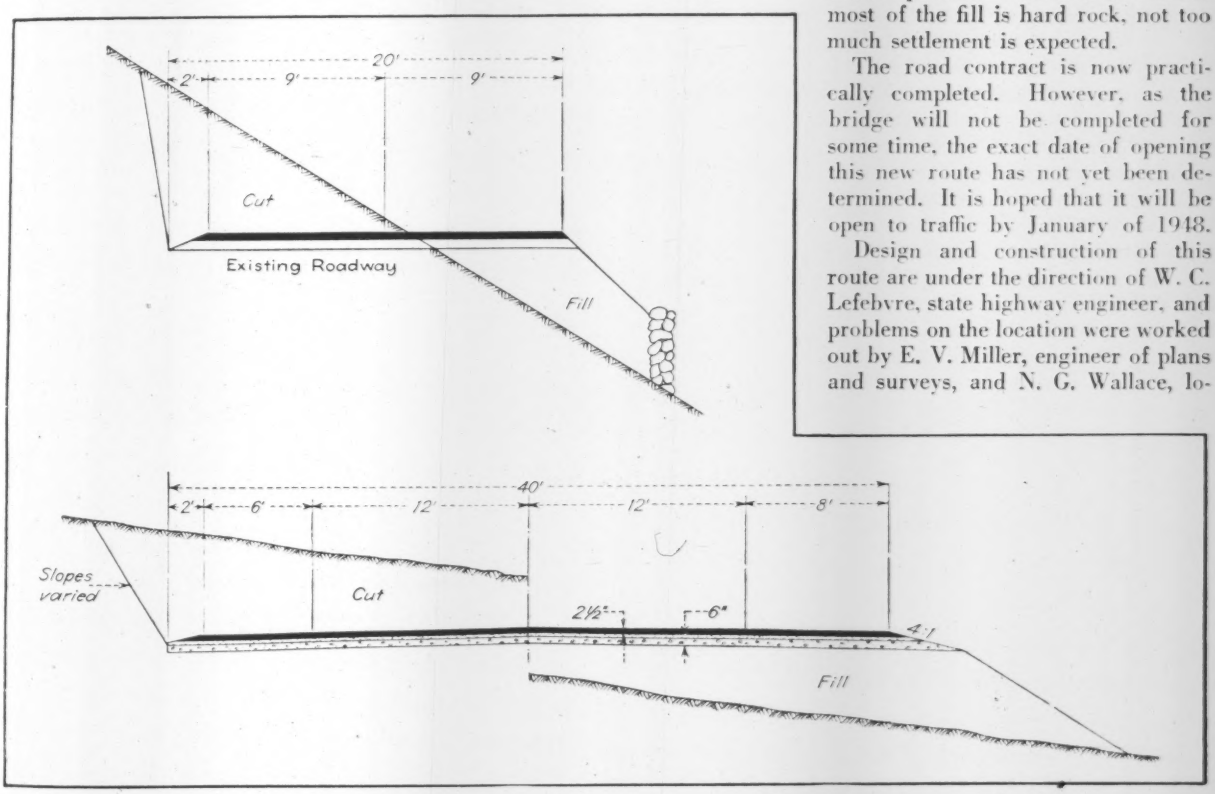


Fig. 3. The old two-lane surface was only 20 ft. wide but the new is 40 ft. wide. Lane widths are 9 and 12 ft., respectively.

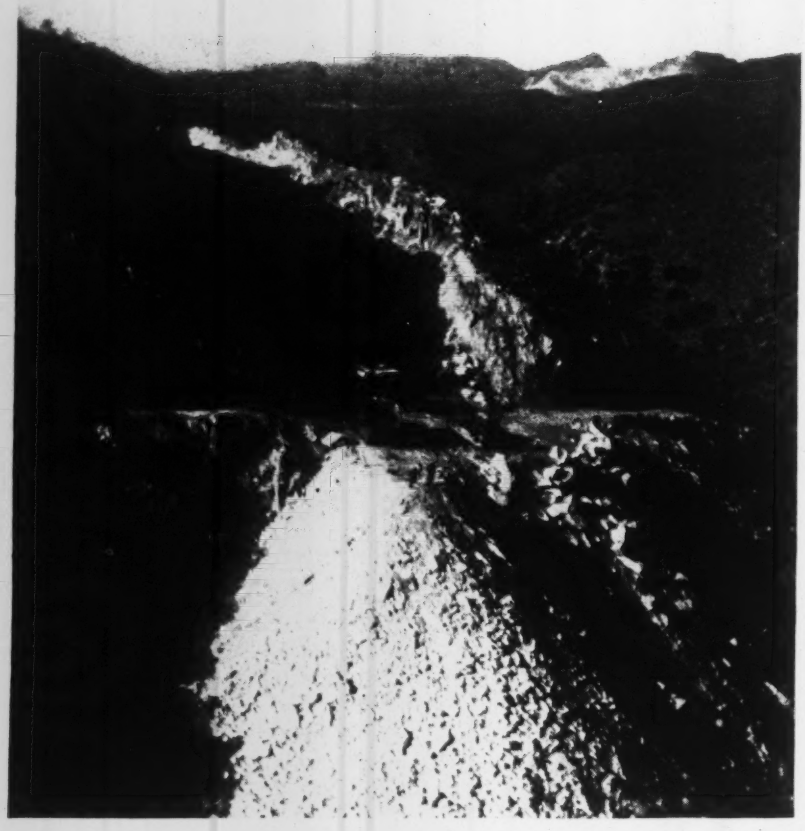


Fig. 4. The terrain was such that equipment could not easily reach the bottoms of fills sometimes as much as 200 ft. below dumping level.

cation engineer. R. J. Holland is district engineer with headquarters at Safford, Ariz., and C. B. Browning is resident engineer on the project. The contract is held by the Orr & Orr Construction Co., Phoenix, and is under the supervision of W. E. Orr, one of the partners.

Airports Set Revenue Record

For the first time in U. S. aviation history, a significant number of city-owned airports are making money on operations according to the International City Managers' Association.

Municipal airport revenues exceeded operating costs last year in 52 cities over 10,000 population. Mounting revenues reflect postwar air travel increases, increased landing fees charged aircraft operators, and expansion of concessions at airports such as restaurants and shops.

As a group, however, city-operated airports are still not self-supporting. Operating costs of 155 city-owned and operated airports totalled $7,074,900, while total revenues were $6,069,900, leaving a $1,055,000 deficit. These figures cover virtually all major airports in the U. S. except those in New York City.

A comprehensive airport survey conducted for the 1947 Municipal Yearbook revealed that of 927 cities over 10,000 population, 247 own and operate one or more airports, and 153 own airports leased to the federal government or private operators. At least 489 cities over 10,000 do not own airports.

Most of the money-making airports belong to cities in the 100,000 to 500,000 bracket. Among these with biggest ratios of revenues to operating costs are Dallas, Texas (Love Field 1946 revenues $105,100, expenses $78,400), Forth Worth, Texas (Meacham Field revenues $273,600, expenses $139,900), and Oakland, Calif. (Municipal Airport revenues $175,400, expenses $128,600).

Municipal airports in only two cities over 500,000 reported revenues exceeding operating expenses—Los Angeles and St. Louis. Chicago's three city-operated airfields fell just $4,000 short of balancing revenues against operating costs. City-operated airports in Baltimore, Buffalo, Detroit, Philadelphia, and San Francisco all reported considerable operating losses.

Payrolls greatly increased

Expansion of air facilities has increased airport payrolls considerably. A total of 1,975 full-time employees and 198 part-time employees were reported by 178 airports in cities over 10,000. New York City's La Guardia Field reported 127 full-time employees. Philadelphia's two airports reported 97 each. Los Angeles and St. Louis reported 82 and 56 employees, respectively.

Management of airports by airport managers or boards are the most popular kinds of airport administration. Airports are administered by managers in 116 cities, by boards or commissions in 100 cities, by divisions of city departments in 16 cities. Two airports are managed by an airport authority. New York's airfields, including Floyd Bennett, Idlewild, and La Guardia, recently were leased to and are managed by the Port of New York Authority.

Among 738 cities between 5,000 and 10,000 population reporting, 84 own and operate airports, 79 lease their airports to private operators or to the federal government, and 575 do not own airports. A total capital investment of $26,719,900 in airports and facilities is reported by 127 cities in this population group owning airports.

For 1945, 37 of these airports reported a total operating expenditure of $150,600 and a total revenue of $93,800. Only three airports in this group reported 1945 revenues higher than $10,000 each.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Manila Job Not Awarded

Sir: It is desired to call your attention to a misstatement of the work to be accomplished with the $18,000,000 authorized for the rehabilitation of the Philippine harbors (*ENR* April 10, 1947, Vol. p. 551). The Drake-Utah-Grove Contractors have not been awarded the contract for this work as stated. Drake-Utah-Grove has however been awarded the contract for permanent military construction in the Philippine Islands.

The port rehabilitation work is under the supervision of the Corps of Engineers; the design, plans, and specifications are being prepared in Manila and all work will be advertised and let under competitive bidding by local and United States contractors. The larger projects will be published and circulated in the United States through the Western Ocean Division, Sausalito, California.

Since we hope that both local and United States contractors will take an active interest in bidding our projects, it will be appreciated if a corrective statement can be published.

COL. CLARENCE RENSHAW, CE,
District Engineer,
Manila District.
Corps of Engineers,
War Department.

Mud-Heaving Problem Solved

Sir: In your issue of May 1, 1947, the article, "Drydock for a Giant Flying Boat" (*ENR* May 1, vol. p. 730) mentions that considerable difficulty was encountered during construction of the thick base slab with local mud-heaving due to the weight of the concrete. It may be of interest to relate how this problem has been solved successfully by the Corps of Engineers in the New Orleans District, where wet heavy clay foundations predominate.

For the construction of the Harvey Lock in the Gulf Intracoastal Waterway opposite New Orleans, La., in the early 1930's, it was planned to place the heavy base or floor slab, which was 11½ ft. maximum thickness directly on the exposed ground surface over a part of the foundation and on a 1-ft. layer of graded gravel over the balance of the area. (The gravel was to form a percolation strata for a gas bleeder pipe system.) However, after driving the timber piling, it was decided to make a soil bearing test to determine whether the soil could support the load to be imposed by the placement of the concrete in the floor until the concrete had reached its final set.

It was found that the safe bearing load of the soil was about 330 psf. The test showed that at 800 psf. the top crust of the subsoil ruptured and the test load box receded rapidly, while mud boils occurred around the edges of the load-supporting platform. At a load of 1,000 psf., the load platform on one side had sunk almost 5 in. into the mud while the other side had returned to about its original position.

The maximum soil load due to the thick base was 1,700 psf. Thus, the bearing test indicated that the soil would not support the full weight of the concrete without the possibility of considerable settlement and heaving with consequent damage to the bond between the concrete and steel. Furthermore, settlement would allow the foundation piling to punch through and crack the slab.

To eliminate these disturbances it was decided to stabilize the base with a concrete slab about 12 in. thick. A test slab was placed and a section thereof loaded to the maximum expected floor load. The results were entirely satisfactory, and it was decided to use over the entire area, a "base stabilization slab," cured prior to pouring subsequent concrete. This procedure was very effective, allowed the placing of the concrete floor without mishap, and in addition furnished an excellent working platform for the contractor.

This method has been successfully used for construction of other locks, floodgates, and drainage structures with floor thicknesses varying from 1½ to 11½ ft. in the New Orleans District and is approved standard procedure for all such work in this area under the supervision of the President of the Mississippi River Commission.

The late H. L. Williams, engineer, was largely responsible for the solution of this problem worked out under the direction of Maj. Gen. Max C. Tyler, then district engineer of the First New Orleans District.

JOSEPH J. ROSA
Project Engineer
Mississippi River Commission
Vicksburg, Miss.

Electrical Stabilization of Soil

Sir: In the May 15 issue of *ENR* (vol. p. 822) you printed abstracts of two Russian papers first published in 1941 on "Electrical Stabilization of Soil". The text of this abstract seem to indicate that the electrical stabilization of soil is a novel process. To correct the impression, and to record the existence of "attention and testing by American engineers interested in soil mechanics" (to quote the editor's note), the following references are given:

1. Endell and Hoffmann report on "Electrochemical Hardening of Clay" at the 1936 Conference on Soil Mechanics at Harvard summarized at length in *ENR*, Aug. 20, 1936, vol. p. 270.

2. Work on this same process by Bernatzik and by Leo Casagrande (the latter obtained German patents on the method), summarized in Krynine's *Soil Mechanics*, p. 388.

3. Robert A. Cummings has done considerable work in the use of low voltage-high amperage currents for the internal fusing of clays for sewer tunnel construction in the Pittsburgh area. A summary of Mr. Cumming's findings was published in the writer's report on "Abutments for Small Highway Bridges," Part 3, *Proceedings*, Highway Research Board, 1945, p. 412.

There may be other references to this type of work, but its origin is certainly more than 10 years of age, with apparently independent American and German discovery.

JACOB FELD
Consulting Engineer,
New York.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Forms Adjusted Quickly

Placement of concrete lining on the Friant-Kern Canal is being speeded by the use of a hydraulic jack that quickly adjusts the slip-form liners to the taut wire grade-line set by U. S. Bureau of Reclamation engineers. A horizontal metal bar suspended from a hinge on the side of the lining machine serves as a guide. By this device concrete is laid to 3½-in. uniform thickness.

Welding Heals Lamp Post Breaks

Frequent targets of careless drivers and accidental mishaps, thousands of lamp posts in the City of New York have been a financial headache for the city fathers. Casualty costs —especially among the cast iron bases—have been high. Replacements average about $45.00 each.

Recent material scarcities and insufficient foundry capacity have made it almost impossible to obtain replacements. Temporary repairs to damaged fixtures have been made until new units could be obtained.

Early this year, the Welsbach Street Lighting Corporation, a maintenance contractor, experimented with making permanent repairs to 450-lb. cast bases.

In making the first repair, welders used newly-developed Ni-Rod electrodes, especially designed for making easily machinable and readily applied welds with cast iron.

In this case, the break girdled the base from one side of the wire-repair door to the other. The upper part of the lamp post was supported by a block and tackle above the lower half, so that the edges of the break fitted together neatly. The two pieces were then tacked together (at 90 degree intervals) with four small deposits from $\frac{5}{32}$-in. Ni-Rod. Skip-welding to keep stresses equal, was used to complete the job. The beads were about 1½-in. long.

The ease of making the repair and the strength of the finished weld have proven the worth of the method. The total cost, including electrodes and welder's time, amounted to $12.50—a saving of $32.50 over the replacement cost of $45.00.

Courtesy of The International Nickel Co., Inc.

Permanent repair to the cast iron base of this lamp post was made at a cost of $12.50, using the newly-developed Ni-Rod electrode especially designed for cast iron. This represented a saving of $32.50, since the cost of a new replacement is $45.00.

Field and Office Comment

Moment of Inertia of Rivets

Sir: Any designer who has to compute rivet groups frequently should be greatly indebted to Robert H. Chambers for presenting a simple method of finding the moment of inertia of such groups (*ENR* March 6, vol. p. 393). This is a considerable simplification of the formula for the moment of inertia submitted by the writer (*ENR* Feb. 21, 1946, vol. p. 302).

However, an error crept into the example given by Mr. Chambers. The rivet group presented in Fig. 2 has a 2-in. horizontal pitch, considering the group as a whole. But separating the 7 horizontal rows of 4 rivets each from the 6 rows of 3 rivets gives us two individual groups with a horizontal pitch of 4 in. for each. Therefore 4/3 should be used for the correction, and the correct solution of the example is

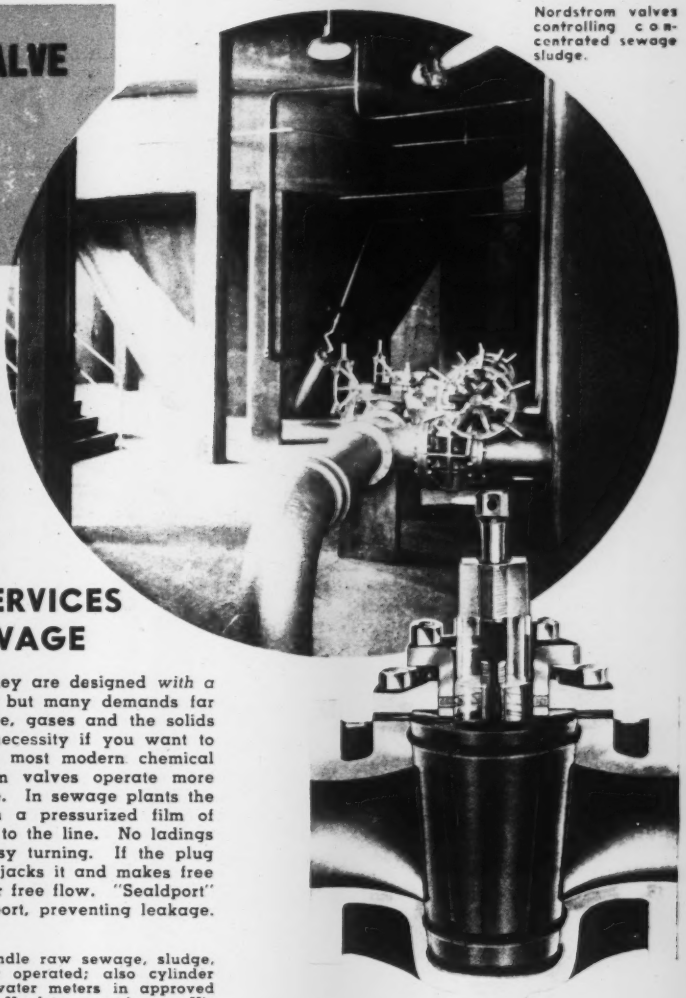
$$4 \times 28 \times 9 = 1{,}008$$
$$3 \times 21 \times 7.5 = 472$$
$$I_x = 1{,}480$$

$$7 \times 10 \times 6 \times 4/3 = 560$$
$$6 \times 6 \times 4 \times 4/3 = 192$$
$$I_y = 752$$

$$I_p = 1{,}480 + 752 = 2{,}232$$

The writer also tried to be consistent in arranging the various factors, so they may be easier recognized: first the number of rows, then the summation, then the distance from the neutral axis and finally the correction factor.—FREDERICK T. VOGT, *Structural Designer, Bureau of Bridges and Buildings, City of Milwaukee, Wis.*

IT TAKES A LUBRICATED VALVE with tapered plug TO HANDLE SEWAGE SLUDGE



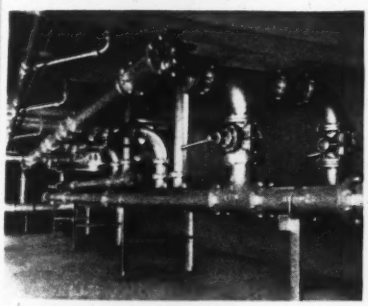
Nordstrom valves controlling concentrated sewage sludge.

IN HANDLING sewage, engineers are confronted with this fact—*lubricated plug valves must be used.* Why? Because (1) the interior of the valve must be streamlined; (2) there must be no pockets or grooves in which sludge can lodge; (3) the valve seat must not be exposed to the line contents; (4) the valve must open and close in minimum time and with least mechanical motion; (5) a pressure seal must be provided around each port to prevent leakage.

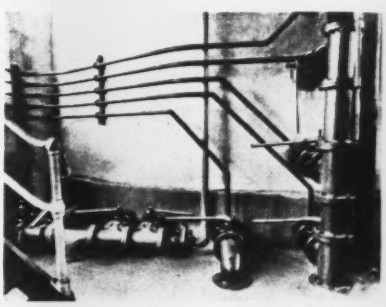
NORDSTROM VALVES ARE IN SERVICES FAR MORE SEVERE THAN SEWAGE

Nordstrom valves handle sewage *right in stride* because they are designed *with a tapered plug,* not only to meet the foregoing requirements, but many demands far more severe. The corrosive and abrasive action of sewage, gases and the solids carried in sewage makes the use of Nordstrom valves a necessity if you want to avoid a breakdown or plant stoppage. Engineers in the most modern chemical plants and refineries know by experience that Nordstrom valves operate more satisfactorily and are by far the most economical in service. In sewage plants the Nordstrom design is ideal. The *tapered* plug, seated on a pressurized film of lubricant, is *constantly* seated. The seat is never exposed to the line. No ladings or grit can intrude. The tapered seat likewise insures easy turning. If the plug ever becomes too tight, a few turns of the lubricant screw jacks it and makes free turning. The smooth interior flow passage is streamlined for free flow. "Sealdport" lubrication provides a positive pressure seal around each port, preventing leakage. Nordstrom valves *keep upkeep down.*

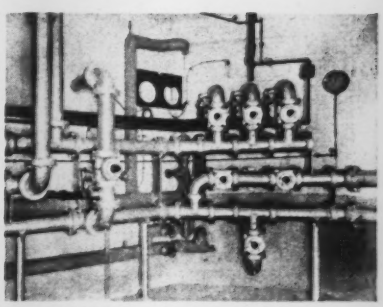
We make lubricated plug valves for sewage up to 30", to handle raw sewage, sludge, acids, chemicals, gas, caustics, air, water. Wrench or gear operated; also cylinder operated for remote control. Also Emco sludge gas meters, water meters in approved types for every purpose, and Emco gas regulators. Call in a Nordstrom engineer. His experience in sewage valve problems may prove helpful. Or write for descriptive Bulletin.



Nordstrom valves on sludge lines.



Valves in a digestor control room.



Valves on sludge manifold.

Nordstrom LUBRICATED VALVES

NORDSTROM VALVE DIVISION — ***Rockwell Manufacturing Company***

Main Offices: 400 North Lexington Avenue, Pittsburgh 8, Pa., Atlanta, Boston, Chicago Houston, Kansas City Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa

Export: Rockwell International Corporation, 7701 Empire State Bldg., New York 1, N. Y.

UNIT PRICES BID BY CONTRACTORS

Highway Improvement, New Hampshire

OWNER: Highway Department, New Hampshire; Robert W. Whitaker, Construction Engineer; Earl Davis, Resident Engineer.

PROJECT: Construction of 3.269 miles of a 21 ft. pavement. Road is to be gravel surfaced. A gravel overhaul cost of $12,200 is added to the job since the nearest largest supply of gravel is a commercial pit 7 miles from the project.

CONDITIONS: Owner will furnish all reinforced concrete pipe to be delivered to the project by the State of New Hampshire. Contractor, however, is to lay the pipe. Access to job is available by rail and highway. Contract time is 80 working days. Skilled labor wage rates range from $1.25 to $1.90 per hr. and semi-skilled from $1.05 to $1.50. Common labor rate is $1.00 per hr.

BIDS: Four bids were received, ranging from the contract low of $115,699 to $128,912. The contract was awarded on June 18, 1947.

LIST OF BIDDERS:

1. Landers and Griffin, Inc., Portsmouth, N. H. (contract) $115,699.00
2. Weaver Bros. Const. Co., Inc., Concord, N. H. $120,649.00
3. Manchester Sand, Gravel and Cement Co., Inc., Manchester, N. H $122,750.40
4. Thibodeau Const. Co., Wolfeboro, N. H..... $128,912.00

	Item	Quantity	Unit Prices (1)	(3)	(3)
1	Clearing and grubbing	8 a	400.00	400.00	500.00
2	Removing trees	153 ea	25.00	25.00	30.00
3	Removing aban. road surface	2,500 sy	.20	.20	.25
5.1	Earth excavation	33,600 cy	.80	.85	.80
6.1	Earth trench excavation R	2,000 cy	1.50	2.00	2.00
6.2	Ledge trench excavation R	50 cy	5.00	5.00	5.00
11.1	Earth borrow	14,600 cy	.75	.75	.80
14.1A	Gravel borrow bridge	600 cy	1.00	1.25	.85
14.1	Gravel borrow	8,300 cy	.85	.85	.85
14.2	Gravel overhaul	122,000 cym	.10	.10	.10
15	Fine grading	113,000 sy	.08	.10	.10
16	Gravel borrow base course	11,200 cy	.90	.85	.85
19.1	Gravel surface course	4,300 cy	1.25	1.25	1.30
20	Class A bit. surf. treatment	28,000 gal	.20	.20	.20
38.4	Mortar rubble masonry	42 cy	20.00	20.00	25.00
40.11-A	Laying 12" R. C. pipe	2,200 lf	1.10	1.10	1.00
40.11-B	Laying 15" R. C. pipe	656 lf	1.25	1.25	1.25
40.11-C	Laying 18" R. C. pipe	64 lf	1.50	1.50	1.60
40.11-D	Laying 48" R. C. pipe	100 lf	5.00	5.00	6.00
60.1	Cable guard rail (wood posts)	400 lf	.75	.75	1.00
61	Anchorages	6 ea	20.00	20.00	20.00
63.1	Wood post markers	50 ea	3.00	3.00	2.00
64.1	Catch basins type A	9 ea	150.00	150.00	140.00
64.3	Catch basins type C	11 ea	150.00	150.00	160.00
64.7	Manholes	5 ea	150.00	200.00	160.00
66	Gran te curb inlets A	2 ea	25.00	25.00	25.00
67	Traps	6 ea	25.00	20.00	30.00
74	Stock wire fence	2,000 lf	.35	.35	.50
79	Mantenance of traffic	15,500 lf	.20	.20	.22
80	Loam 4" deep	5,000 sy	.35	.35	.50
81	Sod	400 sy	1.50	2.00	2.00
82	Fertilizer for grasses	1,350 lb	.10	.10	.10
83	Grass seed	113 lb	1.00	1.00	1.00
90	Dust laying	15,500 lf	.10	.10	.10

Big Dry Creek Reservoir, California

OWNER: U. S. Engineers, Sacramento, California.

PROJECT: Construction of an earthfill flood control dam, canals and spillways. Total length of Big Dry Creek Reservoir is to be 18,800 ft., and maximum height to be 42 ft. above natural ground level. Top widths of various sections of earthen dams and dikes in project will range from 15 to 25 ft. The project includes the construction of Dry Creek dam 2,500 ft. long with dike 16,500 ft. long connecting Dry Creek and Big Dry Creek and is designed to protect Clovis and Fresno districts from flood danger. Reservoir will control a maximum flood of 22,800 acre ft. of water with an estimated inflow of 17,000 cu. ft. a second for 8 days, or 58% more volume than maximum historical flood record.

CONDITIONS: Contractor is to install 60,000 lbs. of equipment furnished by United States. Access to job site is available by both rail and highway. Contract time is 15 months. Skilled labor wage rates are $1.375 per hr.; semi-skilled, $1.15 per hr., and common, $1.15 per hr.

BIDS: Eleven bids were received, ranging from the contract low of $762,895.80 to $1,360,711. Contract was awarded about March 31, 1947.

LIST OF BIDDERS:

1. H. Earl Parker, Marysville, Cal. (contract) .. $762,895.80
2. Morrison-Knudsen and M. H. Hassler, Santa Ana, Cal. 859,658.00
3. Bressi and Bevanda Constructors, Los Angeles, Cal. 942,503.00
4. L. A. and R. S. Crow and W. R. Schriver, Los Angeles, Cal. 978,735.00
5. Fredrickson and Watson Constr. Co., Oakland, Cal. 981,210.50
6. Haddock Engineers, Ltd., Oceanside, Cal. 1,063,467.00
7. A. Teichert and Sons, Inc., Sacramento, Cal. 1,082,765.00
8. Guy F. Atkinson Co., South San Francisco, Cal. 1,184,760.00
9. Piombo Constr. Co., San Francisco, Cal. 1,218,594.00
10. Peter Kiewit Sons Co., Omaha, Neb. 1,222,485.00
11. Macco Corp., Clearwater, Cal. 1,360,711.00

	Item	Quantity	Unit Prices (1)	(2)	(3)
1	Diversion and care of water during const	lump sum	$3,650.00	$5,000.00	$2,000.00
2	Clear and grub	lump sum	300.00	2,750.00	2,000.00
3	Stripping	80,000 cy	.12	.16	.15
5	Common excav., unclassified	500,000 cy	.114	.175	.21
6	Struct. excav., unclassified	15,000 cy	.90	2.00	.50
7	Borrow excav., unclassified	1,550,000 cy	.166	.175	.21
8	Blasting	1,000 cy	.90	2.25	1.25
9	Embankment	1,350,000 cy	.036	.06	.08
10	Rolling, one tractor with one 8-ft. width tamping roller	1,200 hr	8.40	15.00	8.00
11	Compacted backfill	6,000 cy	1.80	2.50	2.40
12	Uncompacted backfill	1,000 cy	1.20	.40	.50
13	Struct. concr.	1,400 cy	54.92	55.00	60.00
14	Paving concr.	700 cy	36.54	30.00	30.00
15	Misc. concr.	160 cy	35.88	100.00	50.00
16	Steel reinf.	270,000 lb	.12	.09	.09
17	Metal water stop	350 lf	1.85	3.50	1.50
18	Expansion joint filler	1,200 sf	.41	1.00	.40
19	Gravel blanket	2,600 cy	5.85	6.70	6.00
20	Rock paving	160 sq	60.00	48.00	35.00
21	Grouting	160 cy	65.00	18.00	15.00
22	Riprap	2,000 cy	8.00	3.25	8.00
23	Quarry rock or cobbles	1,300 cy	5.00	8.00	6.00
24	Tile drain	110 lf	1.45	4.50	3.00
25	Road surfacing, graded agg.	5,300 cy	6.25	4.60	4.50
26	Install. of equip. furnished by U. S.	60,000 lb	.25	.12	.08
27	Elec. systems	lump sum	1,820.00	6,500.00	1,500.00
28	Struct. steel	10,000 lb	.34	.40	.25
29	Misc. metal work	10,000 lb	.56	.65	.55
30	Precast concr. pipe, 48"	124 lf	16.50	22.00	7.00
31	CMP EY inch	50 lf	9.60	12.00	8.00
32	Recorder house	lump sum	2,360.00	1,500.00	2,000.00
33	Staff gages	175 lf	5.00	4.00	10.00
34	Gate house Big Dry Creek Outlet	lump sum	3,752.00	2,000.00	750.00
35	Gate house Little Dry Creek Outlet	lump sum	3,752.00	2,000.00	1,500.00
36	Water for compaction	50,000 gal	1.25	1.50	1.20
37	Port. cement at mixing plant	3,500 bbl	4.00	3.80	4.00
38	Rolling ea. addtl. 8-ft. width tamping roller	1,200 hr	2.40	2.00	2.50

Housing Construction at Fort Worth Army Airfield, Texas

OWNER: U. S. Engineers, War Department, Galveston, Texas.

PROJECT: Construction in connection with the building of 2 unit apartments of stucco and plaster at the Fort Worth Army Airfield, Fort Worth, Texas.

CONDITIONS: All materials are to be furnished by contractor. Access to job site is by rail and highway. The stipulated contract time is 200 days. Skilled labor wage rate is $1.75 per hr., semi-skilled, $1.00, and common, $.80. Electricians receive $1.875 per hr.; bricklayers, $2.25; painters, $1.75; and plasterers, $2.00.

BIDS: Seven bids were received, ranging from the contract low of $752,702.04 to $873,195.13. The contract was awarded June 20, 1947.

LIST OF BIDDERS:

1. McCann Const. Co., Inc., Fort Worth, Tex. (contract) . . . $752,702.01
2. United Const. Co., Dallas, Tex . . . $789,905.10
3. J. W. Bateson Co., Inc., Dallas Tex . . . $791,344.90
4. Oscar Quisle, Fort Worth, Tex . . . $800,577.99
5. Shaw and Estes, Dallas, Tex . . . $807,083.20
6. T. C. Bateson Const. Co., Dallas, Tex . . . $856,861.79
7. J. O. Boyd Const. Co., Dallas, Tex . . . $873,195.13

Item	Quantity	Government Estimate	Unit Prices (1)	(2)
1 2-Unit Apt. bldg; type X	45 ea	$16,945.00	$14,788.00	$15,830.00
3 Pipe, water; existing, remove, 8" dia.	1,440 lf	.305	.88	.56
4 Pipe, water; existing, relay, 8" dia.	1,440 lf	.88	1.42	1.46
5 Pipe, water; cast iron 8" dia. (New)	1,750 lf	2.96	3.46	4.45
6 Pipe, water; cast iron, 6" dia	1,490 lf	2.34	2.73	3.73
7 Pipe, water; steel, galv., 1½" dia.	1,370 lf	.75	.55	1.07
8 Pipe, water; steel, galv., 1¼" dia.	2,970 lf	.64	.49	1.02
9 Hydrants, fire; 6-inch	13 ea	284.85	141.12	120.00
10 Pipe, sewer; V. C., 8" dia	4,340 lf	1.20	3.68	1.51
11 Pipe, sewer; V. C., 6" dia	4,860 lf	.97	1.10	.93
12 Manholes; sewer, 6' deep or less	5 ea	159.50	142.24	86.50
13 Manholes; sewer, 6' to 9' deep	5 ea	224.50	208.32	148.00
14 Manholes; sewer, over 9' deep	2 ea	392.50	208.32	187.04
15 Cleanouts; sewer, 8-inch	4 ea	52.00	21.84	16.04
16 Cleanouts; sewer, 6-inch	57 ea	22.40	13.22	14.24
17 Pipe, gas; 2½" dia.	2,900 lf	1.13	.88	1.33
18 Pipe, gas 2" dia.	1,140 lf	1.08	.77	1.18
19 Pipe, gas; 1¼" dia.	2,450 lf	.77	.55	1.12
20 Pipe, gas; 1" dia.	3,050 lf	.625	.43	.98
21 Pipe, culvert; metal arch (18" x 11")	190 lf	3.50	3.84	3.06
22 Curb; concrete	400 lf	1.80	1.23	1.38
23 Curb and gutter; concrete	4,480 lf	1.53	1.29	1.38
24 Sidewalks; concrete	22,030 sf	.33	.308	.265
25 Platforms, concrete; refuse container	745 sf	.72	.37	.46
26 Gravel; flexible base	2,135 cy	6.85	4.93	5.43
27 Asphalt; bituminous prime coat	3,715 gal	.215	.44	.205
28 Asphalt; single surf. treat	2,785 gal	.23	.44	.185
29 Aggregate; single surf. treat	95 cy	11.93	8.96	6.80
30 Elect. dist. sys	lump sum	11,163.00	11,000.00	10,500.00

Highway, Worthington, Minnesota

OWNER: State Highway Department, St. Paul, Minnesota; O. L. Kipp, Chief Engineer.

PROJECT: Grading, shouldering and paving 12.4 miles of highway between Bigelow and Trunk Highway 16 in Worthington, and between North corporate limits of Worthington to 0.7 mile east of Worthington on Trunk Highway 16.

CONDITIONS: All materials to be furnished by contractor. Access to job site is available by rail, highway, and water. Skilled labor wage rates range from $1.10 to $1.75 per hr.; semi-skilled, from $.80 to $1.55 per hr.; common, from $.70 to $.90 per hr.

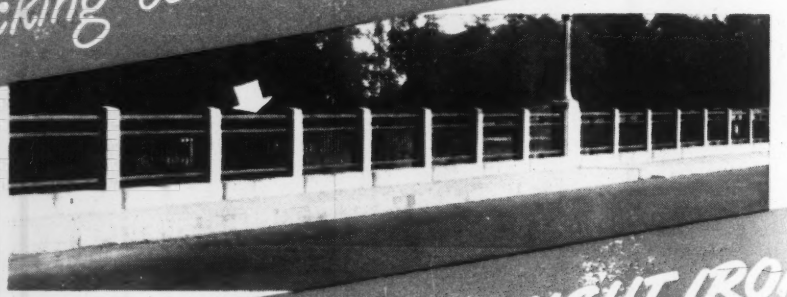
BIDS: Five bids were received, ranging from the contract low of $569,182.91 to $619,605.22. The contract was awarded on March 20, 1947.

LIST OF BIDDERS:

1. Anderson and Sons, Inc., Minneapolis, Minn. (contract) . . . $569,182.91
2. Okes Const. Co., St. Paul, Minn. . . . 588,100.35
3. Woodrich Const. Co., Inc., Minneapolis, Minn. . . . 602,248.49
4. Hallett Const. Co., Crosby, Minn. . . . 604,943.62
5. Western Const. Corp., Sioux City, Iowa . . . 619,605.22

Item	Quantity	Unit Prices (1)	(2)	(3)
1 Clearing	64 tree	$5.00	$5.00	$7.50
2 Grubbing	64 tree	5.00	10.00	5.25
3 Removing portable culverts	1,512 lf	.50	.75	.53
4 Removing curb and gutter	20 lf	.50	.50	.50
5 Removing sidewalks	45 sy	.30	.40	.25
6 Obliterating old roadway	5 a	35.00	120.00	55.00
7 Class "C" excavation	196,617 cy	.31	.27	.34
8 Topsoil covering in place	1,436 cy	1.30	1.30	1.10
9 Hand ditch excavation	15 cy	3.00	2.00	2.00
10 Sand gravel fill in place (box culvert)	274 cy	1.35	1.00	1.50
11 Sand gravel fill in place (subgrade corr.)	6,442 cy	.95	1.00	1.50
12 Excavation of earth mat'l	5,961 cy	.28	.50	.37
13 Haul of earth mat'l	6,073 cy mi	.20	.30	.15
14 Water	296 M gal	3.00	4.00	4.00
15 Exc. of unsuitable mat'l	2,381 cy	.50	.75	.34
16 Salv. bit. mixt. in pl. (tr. meas.)	14,642 cy	1.45	1.60	2.00
17 Relaying 15" S. C. culv.	62 lf	1.10	1.00	.80
18 Relaying 24" S. C. culv.	66 lf	1.20	1.50	1.00
19 Relaying 36" S. C. culv.	78 lf	1.60	2.50	1.50
20 Relaying 15" C. M. culv.	122 lf	.60	1.00	.50
21 Relaying 18" C. M. culv.	316 lf	.75	1.00	.60
22 Conc. headwalls (grade "A")	5 cy	40.00	50.00	40.00
24 Removal of old structures (W 46 x 30) sta. 250 + 75	lump sum	250.00	300.00	100.00
25 Trench excav. 0' to 6' deep (subsurface drains)	245 lf	1.25	2.00	1.00
27 Random riprap (culvert ends)	25 cy	8.00	10.00	10.00
28 Trench excav. 0' to 6' deep (pipe sewers)	911 lf	1.50	2.00	.75
30 Exc. for manholes or catch basins	134 cy	1.75	2.00	1.50
31 Constructing manholes	17 cy	45.00	52.00	40.00
32 Constructing catch basins	14 cy	35.00	52.00	40.00
33 F. and I. casting assemblies	17 ea.	50.00	55.00	62.00
34 Adjusting frame or ring castings	1 ea.	12.00	10.00	7.00
35 Conc. sidewalk (4" thick)	288 sf	.30	.40	.23
36 Conc. sidewalk (6" thick)	48 sf.	.50	.60	.27
37 Conc. eros. cont. structures (cattle pass ramps)	15 cy	30.00	52.00	25.00
39 Project markers	10 ea	10.00	15.00	8.00
40 Roadside seeding	85 a	15.00	12.00	15.00
41 Area sodding	26,108 sy	.33	.40	.32
45 F. and I. 15" S. C. culv.	170 lf	2.75	2.50	2.20
46 F. and I. 18" S. C. culv.	8 lf	3.00	3.00	2.70
47 F. and I. 24" S. C. culv.	488 lf	4.30	4.00	4.10
48 F. and I. 30" S. C. culv.	96 lf	6.40	6.50	6.00
49 F. and I. 36" S. C. culv.	298 lf	7.60	9.00	7.50
50 F. and I. 12" reinforced concrete sewer pipe	283 lf	2.20	2.00	1.90
51 F. and I. 18" reinforced concrete sewer pipe	85 lf	2.80	3.00	2.50
52 F. and I. 24" reinforced concrete sewer pipe	503 lf	4.60	4.00	3.90
53 F. and I. 12" C. M. culv.	32 lf	2.00	2.00	1.60
54 F. and I. 15" C. M. culv.	194 lf	2.30	2.25	2.10
55 F. and I. 18" C. M. culv.	348 lf	2.50	2.50	2.40
56 F. and I. 24" C. M. culv.	54 lf	4.00	4.00	3.75
57 F. and I. 48" C. M. culv.	32 lf	10.80	12.00	10.00
58 F. and I. 15" C. M. pipe	40 lf	2.35	3.00	2.10
59 F. and I. 12" non-perf. metal pipe	245 lf	1.70	2.00	1.80
60 F. and I. met. apr. for 12" C. M. culv.	2 apron	22.00	12.00	13.60
61 F. and I. met. apr. for 15" C. M. culv.	21 apron	22.00	15.00	14.70
62 F. and I. met. apr. for 18" C. M. culv.	30 apron	30.00	16.00	17.50
63 F. and I. met. apr. for 24" C. M. culv.	4 apron	60.00	30.00	29.00
64 F. and I. mat. apr. for 48" C. M. culv.	2 apron	145.00	140.00	125.00
65 Preparation of the subgrade	2,683 cy	1.00	.90	1.00
66 Temporary crossings	11 ea.	50.00	60.00	70.00
67 Integrant curb, type "A" des. A3	166 lf	.20	.30	.25
68 Integrant curb, type "B" des. B10	166 lf	.80	1.00	.25
69 Conc. curb, type "D" des. C9	1,965 lf	.85	1.50	.50
70 Concrete curb and gutter, type "F" des. A 626	2,235 lf	1.40	2.35	1.50
72 Grav. base in place (tr. meas.)	1,036 cy	2.50	1.50	2.25
73 Water	5 M gal	3.00	4.00	4.00
74 Bit. mat'l for prime coat	4,894 gal	.20	.14	.20
75 Bit. mat'l for mixture	7,830 gal	.18	.14	.20
76 Aggregate	489 ton	2.25	2.00	2.00
77 Bituminous surface	4,894 sy	.20	.10	.15
78 One course conc. pave. (air entraining cement)	175,227 sy	2.41	2.50	2.52
79 Class "U" excavation	131 cy	2.00	2.50	2.00
80 Grade "A" concrete	48 cy	50.00	50.00	40.00
81 Reinforcement bars	5,214 lb	.10	.10	.12
82 Exc. for S. C. cattle pass	197 cy	1.00	2.50	.63
83 S. C. cattle pass	140 lf	21.50	25.00	21.00

Triple checking corrosive attack



BYERS WROUGHT IRON

in canopies...
drainage lines...
railings...

Designed by Pennsylvania Railroad engineers, this 9th Street bridge in Washington provides several examples of how bridge structures are being "maintenance-proofed" in vulnerable areas.

The bridge railing, the corrugated metal canopies that shield the power lines, and the six-inch drainage lines running down the inside of each pier, are all exposed to active corrosive attack. Byers Wrought Iron was used for all three: three-inch wrought iron pipe, four-inch wrought iron channels and seven-eighth inch wrought iron bars for the railing, 16-gage wrought iron sheet for the canopies, and six-inch wrought iron pipe for drainage lines.

The choice of wrought iron for all these services is supported by records of successful service in previous applications. Wrought iron's unique composition and structure—tiny fibers of glass-like silicate slag threaded through a body of high-purity iron—gives inherent resistance to corrosion and eliminates any dependence on periodical painting for protection. The slag fibers halt and "detour" corrosive attack, discouraging pitting and rapid penetration. At the same time they help anchor the initial protective scale, which shields the underlying metal.

Our bulletin, "Wrought Iron for Bridge Construction", illustrates and describes a number of applications of wrought iron in bridges, and will provide some helpful tips if you are considering any projects, and want to avoid premature repairs and excessive maintenance. Ask for a complimentary copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco.

CORROSION COSTS YOU MORE THAN WROUGHT IRON.

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

ALL-ALUMINUM BELT CONVEYOR—A pre-fabricated, all-aluminum, belt conveyor called the Mercury has all components such as chain, belt, sprockets, channels, angles, frame and other parts constructed of heat treated aluminum alloy. It is rust and corrosion proof, resistant to most acids, chemicals and fumes. It is available in widths from 6 to 60 in., heights from 15 in. up; standard height is 36 in. It is shipped prefabricated in 5 ft. sections which may be assembled in one continuous unit up to 150 ft. in only a few minutes' time.—*Patron Transmission Co., 129 Grand St., New York 13, N. Y.*

MACHINERY TRAILER — A lightweight double drop machinery trailer fabricated of high tensile strength steels has a weight 5,000 lbs. less than similar equipment. This will permit heavier pay loads, cut maintenance costs, tire wear and operating expense. In some instances it will allow moving of heavy equipment over roads previously barred by gross tonnage restrictions. — *Pointer-Willamette Co., Inc., Portland, Ore.*

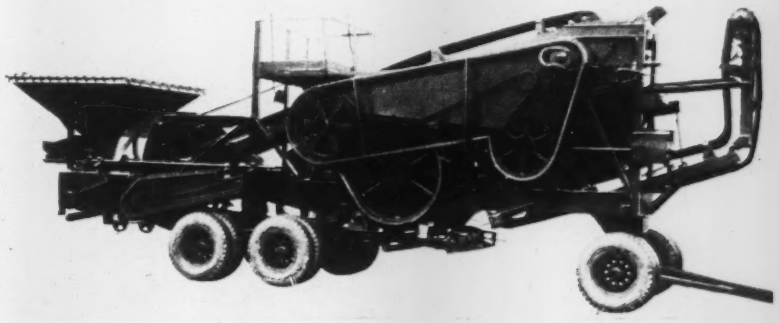
LEVEL AND ANGLE INDICATOR—Usable from all four surfaces with dials visible in any position, Anglevel is equipped with retainers into which two horizontal and two vertical vials are placed. Retainers can be inserted, adjusted and positively locked into position by 10-32 Allen screw in 3 min. Frame is heat-treated aluminum, 16x3x¾ in., and weighs 1½ lb.—*R-D Co., P. O. Box 912, Flint, Mich.*

STUD WELDING—Underwriters Laboratories, Inc., recently listed stud welding as acceptable method for installation of sprinkler hangers. Threaded female studs are welded directly to structural steel and are said to cost one-fourth to one-third as much as beam clamps or other conventional hanger connectors.—*Nelson Stud Welding Corp., 2715 Toledo Ave., Lorain, Ohio.*

CHAIN HOIST—Through the ingenious use of steel and aluminum alloys, the weight of a line of high-speed hand hoists has been reduced to 45 percent lighter than standard hoists of comparable capacity. This makes the hoist far easier and safer to handle and install. Along with weight saving, strength and durability have been increased while all excess bulk has been eliminated. — *Chisholm-Moore Hoist Corp., Tonawanda, N. Y.*

POWDER METALLIZING UNIT — Spraywelder makes it possible to combine advantages of both welding and metallizing procedure. Unit is operated in first part of process as powder metallizing unit to apply uniform overlay of Colmonoy hard-facing alloy. It is then used as conventional welding torch to fuse this sprayed overlay to base metal to obtain fusion or molecular bond, identical to that obtained when same alloy in rod form is applied by acetylene welding. There are only two control valves, both mounted on gun. Once adjusted, the powder flow may be stopped and started at will by pressing or releasing trigger. Gun may be hand operated or held in vise or with attachment in tool post of a lathe.—*Wall Colmonoy Corp., 19345 John R., Detroit 3, Mich.*

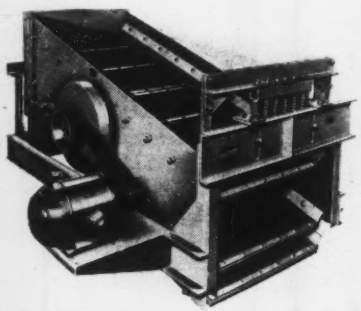
MATERIAL HANDLING MACHINE—Power steering and an enclosed cab are new, optional equipment on standard model Scoopmobile, tricycle-type materials handling machine. Cab features deluxe, full-size upholstered seat, windshield wiper, and large safety plate



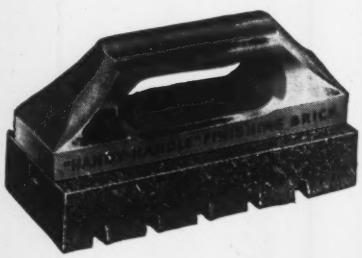
PORTABLE GRAVEL PLANT—High aggregate production is claimed for a new 34-S Continuflo portable gravel plant. Simplified in design, and readily moved, the 34-S is recommended for quick hops and short jobs where material is required in a hurry. It meets state highway load limits for weight and dimensions. The total weight, less power unit is 40,900 lb. It has a travel length of 41 ft. and a height of 12 ft. 9 in. The plant is equipped with six sets of dual 9:00 x 20 pneumatic tires. A 7 ft. hopper, equipped with mechanical feeder, takes the feed at the rear end of the plant. Processed material is delivered from front end.—*Pioneer Engineering Works, Minneapolis, Minn.*

windshield. Both sides have doors that may be latched open in warmer weather. —*Mixermobile Manufacturers, 6853 N.E. Halsey, Portland 16, Ore.*

MASONRY WATERPROOFING — A new substance called Agraseal has been perfected to protect and seal all porous masonry surfaces. The material also beautifies surfaces, is available in white, ivory cream, light buff, natural stone grey, sunny yellow and light green. Applied with ordinary scrub brush, the material penetrates deep into open pores. When it sets, a positive seal is established.—*Tamms Silica Co., 228 North LaSalle St., Chicago 1, Ill.*



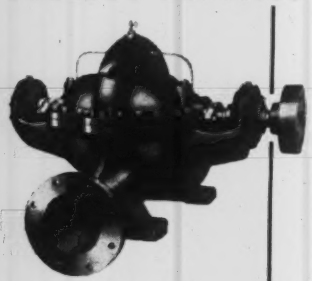
VIBRATING SCREEN—New Telsmith Vibro-King is two-bearing, heavy-duty vibrating screen recommended for finish screening of medium and small-sized aggregates or those passing 4 in. openings and down to the finest mesh sizes. Vibrating unit is mounted in center of live screen frame on two heavy-duty roller bearings and is equipped with two specially designed and patented, automatically adjusted and enclosed counterweights which prevent jumping at critical speeds. Main frame is horizontal for rigidity and ease of installation, and is usually supported from below.—*Smith Engineering Works, Milwaukee, Wis.*



RUBBING BRICK—Handy-handle finishing brick is especially designed and curved for comfortable grip with either hand. Its selected sharp grains make it easy to use. It is ideal for removing

PEERLESS
HORIZONTAL CENTRIFUGAL PUMPS
(Formerly Dayton-Dowd)

TYPE A PUMPS
For General and Process Services



CAPACITIES:
50 to 70,000 g.p.m.

● The Peerless Type A pump is characteristic of the entire line of high quality, heavy duty horizontal centrifugal pumps, manufactured by Peerless to serve the diversified pumping demands of industry, municipalities and water works everywhere.

Peerless Type A Centrifugal Pumps

General Specifications: *Capacities*, from 50 to 70,000 g.p.m.; *Heads*, 15 to 300 feet; *Sizes*, 2" to 42" discharge; *Drives*, electric and other types from 1 to 1000 h.p.; *Type*, single stage, double suction, split-case, ball bearing. REQUEST DESCRIPTIVE BULLETIN.

PLAN WITH PEERLESS

For all your pumping requirements, plan with Peerless. Peerless' comprehensive line of pumps includes Underwriters' approved Fire Pumps for plant fire protection, Boiler Feed and Pipe Line pumps and scores of other vertical and horizontal types producing capacities from 10 to 220,000 g.p.m.

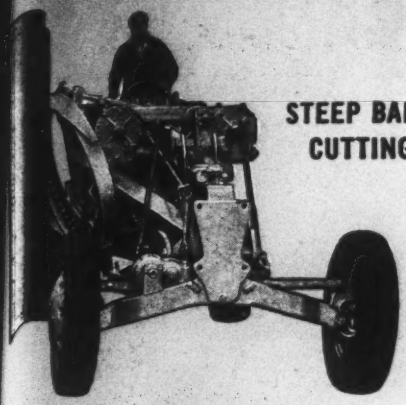
PEERLESS PUMP DIVISION
FOOD MACHINERY CORPORATION
Factories:
Canton 6, Ohio • Quincy, Ill. • Los Angeles 31, Calif.
District Offices: Canton 2, Ohio; Philadelphia: Suburban Square, Ardmore, Pa; Atlanta: Rutland Bldg., Decatur, Ga.; Dallas 1, Tex.; Los Angeles 31, Calif.

Adams
DISTRIBUTORS
Headquarters for MACHINERY and SERVICE

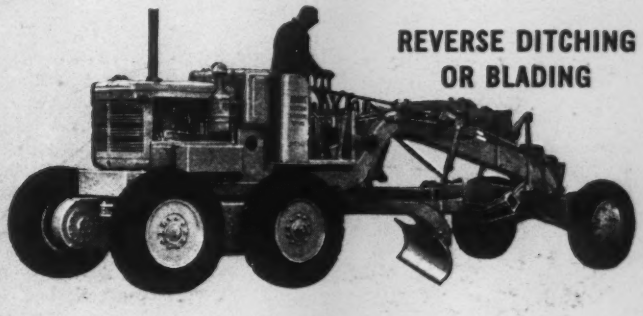
ALA. Montgomery—Ray-Brooks Machinery Company
Birmingham—Tractor & Equipment Company
ALASKA Fairbanks—Glenn Carrington & Company
ARIZ. Phoenix—The O. S. Stapley Company
ARK. Little Rock—Little Rock Road Machinery Co.
CALIF. Western Factory Branch
J. D. ADAMS MANUFACTURING CO.
230 7th Street, San Francisco 3
Adams Distributors at: San Francisco, Los Angeles, Sacramento, Redding, Riverside, San Jose, Fresno, Stockton, Salinas, Santa Rosa, Modesto, Visalia, Merced, Bakersfield, Santa Maria and San Diego
COLO. Denver—McKelvy Machinery Company
CONN. New Haven—W. I. Clark Company
DEL. Phillips Machinery & Tractor Co., Baltimore
FLA. Jacksonville, Miami, Tampa—Florida Equipment Co.
Pensacola—Ray-Brooks Truck & Tractor Company
GA. Atlanta—Tri-State, Inc.
Albany—Tri-State Tractor Company
IDA. Boise & Pocatello—Intermountain Equipment Co.
ILL. Peoria & Springfield—A. E. Hudson Company
Salem, Carmi—E. W. Werner Equipment Company
Chicago—R. C. Larkin Co.
Quincy—Missouri-Illinois Tractor & Equip. Co.
IND. Indianapolis—Indiana Equipment Co., Inc.
Evansville—Brandeis Machinery & Supply Co.
IOWA Des Moines—Herman M. Brown Company
KANS. Wichita—S. H. Denney Road Machinery Co.
KY. Louisville—Brandeis Machinery & Supply Co.
LA. Baton Rouge, Monroe, New Orleans — Dunham-Pugh Co., Inc.
MAINE Portland—Maine Truck-Tractor Co.
MD. Baltimore—Phillips Machinery & Tractor Co.
MASS. Newton Upper Falls—United Equipment Corp.
MICH. Bark River—Bark River Culvert & Equipment Co.
Detroit and Grand Rapids—
Wolverine Tractor & Equipment Co.
MINN. Minneapolis & Duluth—Rosholt Equipment Co.
MISS. Jackson—Mississippi Road Supply Co.
MO. St. Louis—Missouri-Illinois Tractor & Equip. Co
Kansas City—Noel V. Wood, Inc.
MONT. Billings & Missoula—Industrial Equipment Co.
Great Falls—Hi-Line Equipment Co.
NEB. Omaha—Nebraska Tractor & Equipment Company
North Platte—Cornhusker Tractor & Equip. Co.
NEV. Reno—Brown Motors
N. H. Manchester—R. C. Hazelton Co.
N. J. Union—Ehrbar Equipment Co.
N. M. Albuquerque—Hardin & Coggins, Inc.
N. Y. Buffalo—Dow & Company, Inc.
Brooklyn—Edward Ehrbar, Inc.
Albany, Syracuse—Milton-Hale Mach. Co.
N. C. Raleigh—J. B. Hunt & Sons
N. D. Fargo—Myhra Equipment Company
OHIO Cleveland—Gibson-Stewart Company
Cincinnati—Rish Equipment Co.
Cambridge—Major Equipment Co.
Richwood—Hamilton Equipment Co.
OKLA. Tulsa & Guthrie—C. L. Boyd Company, Inc.
ORE. Portland & Eugene—Howard-Cooper Corporation
PA. East Butler—Walsh Equipment Co.
Pittsburgh—Atlas Equipment Corp.
Philadelphia—Service Supply Corp.
Harrisburg & Wilkes-Barre (Kingston)—
State Equipment Co.
R. I. Providence—Tractors, Inc.
S. C. Columbia—N. H. Summers Road Machinery Co.
S. D. Sioux Falls, Rapid City—Empire Equipment Company
TENN. Knoxville & Chattanooga—Power Equipment Co.
Nashville—Industrial Tractor & Equipment Co., Inc.
Memphis—Road Builders Equipment Co.
TEXAS Dallas & Houston—Browning-Ferris Machinery Co.
San Antonio—Jess McNeel Machinery Co.
Plainview, Abilene, Odessa—Plains Machinery Co.
El Paso—Hardin and Coggins, Inc.
UTAH Salt Lake City—The Lang Company, Inc.
VA. Richmond and Roanoke—Rish Equipment Co.
Alexandria—Phillips Machinery & Tractor Co.
WASH. Seattle—Howard-Cooper Corp.
Spokane—Intermountain Equipment Co.
W. VA. Charleston and Clarksburg—Rish Equipment Co
WIS. Milwaukee, Eau Claire & Green Bay—Bark River Culvert & Equipment Co.

SEE **Adams** AD ON OPPOSITE PAGE

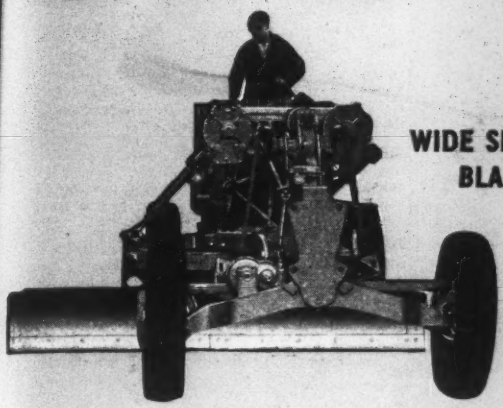
Adams Motor Graders
Your best buy—all ways



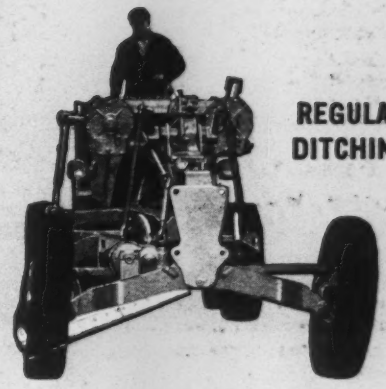
STEEP BANK CUTTING



REVERSE DITCHING OR BLADING



WIDE SHOULDER BLADING



REGULAR DITCHING

More Blade Positions

WITHOUT MECHANICAL ADJUSTMENTS

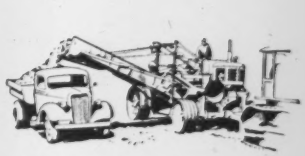
● Adams fast power-operated mechanical control system gives you the full range of blade positions shown above . . . *with blade centered on circle—without adjusting blade lift links.*

This important Adams advantage permits operator to obtain *all* average blade positions through simple maneuvering of the control levers—*without leaving the cab.* Even on more extreme work (which is seldom encountered) required blade positions are quickly obtained through easy adjustment of the telescopic lift links. Rarely is work so extreme that blade must be shifted on circle.

Here you have one more specific example of how Adams Motor Graders speed operations—reduce operator fatigue—improve work—lower operating costs. Ask your local dealer to demonstrate how Adams Motor Graders are *your best buy—in this way—and all ways.*

J. D. ADAMS MANUFACTURING CO. • INDIANAPOLIS, INDIANA

Adams



MOTOR GRADERS • LEANING WHEEL GRADERS • ELEVATING GRADERS

Friend OR ENEMY?

An eraser is an important part of any draftsman's equipment. But an eraser can do plenty of damage to your drawings if lines feather when you re-ink over an erasure. That's why Arkwright Tracing Cloth is made to stand erasures and still take clear sharp lines in pencil or ink.

High, permanent transparency, greater strength, and freedom from dirt, specks, pin-holes and other imperfections have made Arkwright Tracing Cloth the choice of experienced draftsmen for over twenty years. That's a record you'd do well to look into, and learn for yourself the "reasons why". For free samples of Arkwright Tracing Cloth write – right now – to Arkwright Finishing Company, Providence, R. I.

★

Sold by leading drawing material dealers everywhere

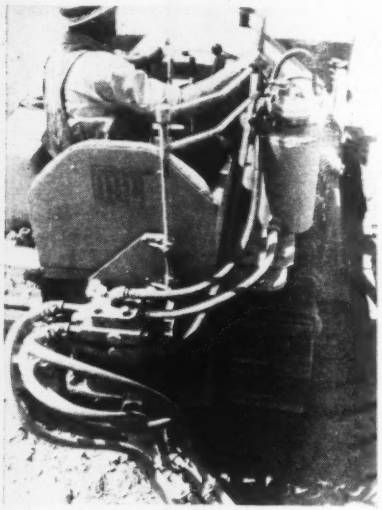
★

Arkwright

TRACING CLOTHS

AMERICA'S STANDARD FOR OVER 20 YEARS

form marks from concrete surfaces, leveling insulating brick, or rounding edges, for special installations. Available without handles. Sizes are 2x2x6 in. and 2x2x8 in.—*Clipper Mfg. Co., 2800 Warwick, Kansas City 8, Mo.*

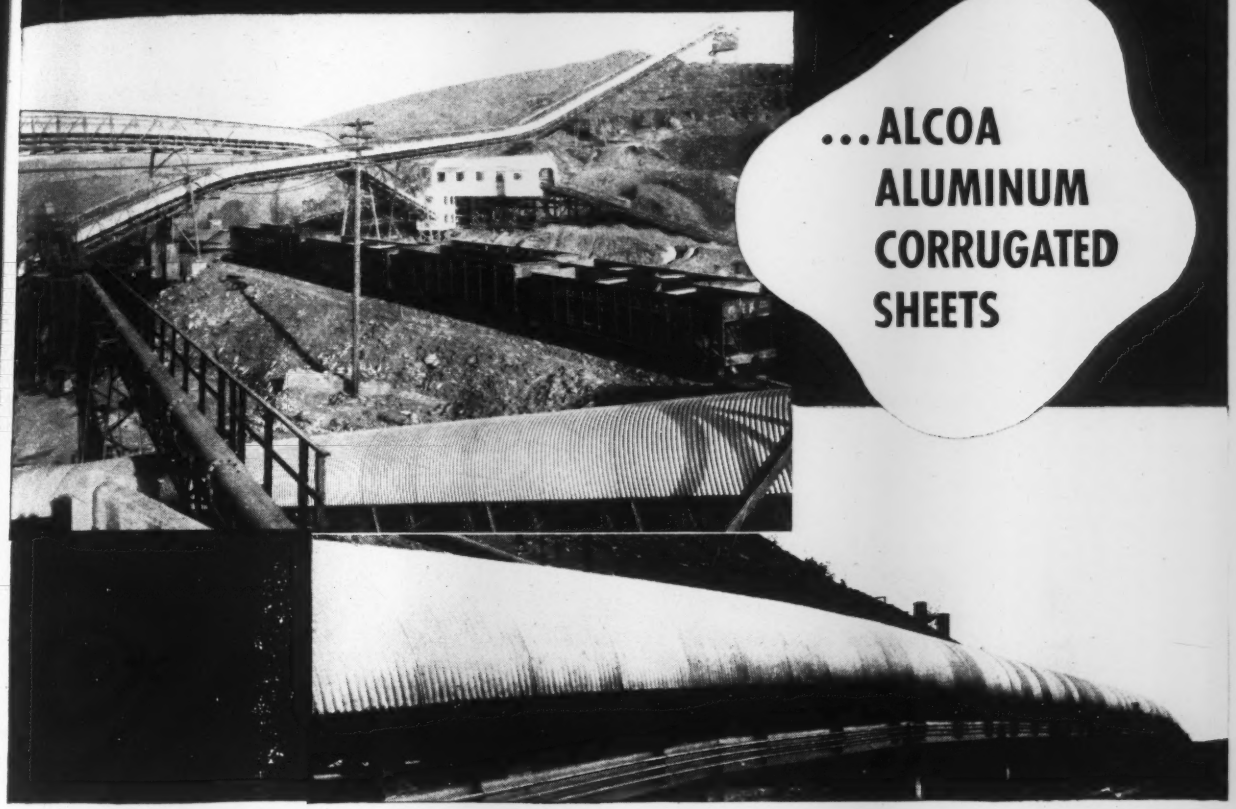


HYDRAULIC TRACTOR UNITS—Low-cost hydraulic conversion "packages" hook into existing hydraulic systems, making it possible to operate a 2 or 4 yd. scraper in combination with present 'dozers without having to purchase an additional hydraulic system for scraper operation. The conversion units are available in two designs—one for adapting the new 2-cu. yd. LaPlant-Choate scraper to present D-2 hydraulic 'dozers and the other for adapting the 4-cu. yd. scraper model to D-4 'dozer units.—*LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa.*

POWER TOOL—New industrial powder-powered tool named "Drive-it" instantly drives anchor studs as much as 3 in. into average concrete, punches holes through steel plate up to $\frac{3}{8}$ in. in thickness and rivets together two steel plates totaling as much as $\frac{3}{4}$ in. in thickness. Model 38, weighing only 7 lb., delivers 20-ton blow. This power is derived from charge of special powder incased in small cartridge. Special recoil mechanism absorbs all shock. Anchor studs driven into ordinary concrete by this tool will withstand direct pull from 2,000 to 4,000 lb., and will withstand pull in excess of 5,000 lb., when driven into steel plate.—*Powder Power Tool Corp., 618 North Vancouver Ave., Portland, Ore.*

What's Tougher Than

15 YEARS of SUMMER RAIN AND COAL DUST?



...ALCOA ALUMINUM CORRUGATED SHEETS

At the breakers of The Philadelphia & Reading Coal & Iron Company, about four miles of conveyor belts are roofed with Alcoa Aluminum Corrugated Sheets. Both surfaces of the aluminum are blanketed under layers of coal dust. Rain and moisture quickly bring out all the sulfates and meanness in this coating. The pH of the mixture of water and coal is about 2.6 . . . very high on the acid side, and quick poison for most metals.

But not for Alcoa Aluminum! After 15 years of service, these aluminum covers were inspected. The deepest penetration of the aluminum on representative samples was only 0.004" . . . after 15 years! The average depth of penetration was less than 0.001". The verdict of the inspectors was "Good for years and years more service".

When you come up against tough or severe corrosion problems in the structures you build, investigate "Alcoa Aluminum". It's available in sheets, structural shapes, and every commercial form, in a wide range of alloys to meet all conditions of service. ALUMINUM COMPANY OF AMERICA, 2108 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in leading cities.

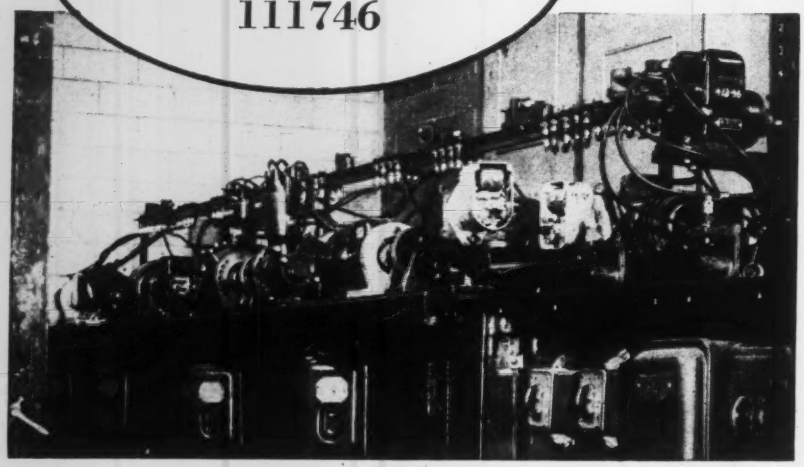
MORE people want MORE aluminum for MORE uses than ever

ALCOA ALUMINUM

ALCOA ALUMINUM

IN EVERY COMMERCIAL FORM

Biography of WICO magneto 111746



About sixty WICO magnetos a month are taken from the production line, put on a test bench and given an operating-life test. Here's an excerpt from the report of the Engineering Department on #111746 after nearly three months' testing, "Magneto was examined after 1936 hours. Bearings were tested and were within gauge tolerances. Other parts also O.K. The test was continued."

Such care in manufacture, such application of engineering skill to production, are what make a WICO the best magneto buy. The postwar "X" models are the last word in magneto development, the result of 50 years of building fine ignition equipment. They're built to 1947 aircraft standards, and equip some of the finest spark-ignited engines in the world. More than a thousand authorized service stations and a specially trained corps of field engineers serve WICO buyers and users everywhere. Wico Electric Company, West Springfield, Massachusetts.

WICO MAGNETOS 50 YEARS OF DEPENDABLE IGNITION

Diamond Core Drilling

CORE BORINGS for Foundations, Dams, Bridges and all Heavy Structures GROUT HOLES

Tinney Drilling Co.
Grafton, W. Va.

BELMONT IRON WORKS
PHILADELPHIA ROYERSFORD EDDYSTONE

Fabricators *Contractors*
Exporters

STRUCTURAL STEEL
BUILDING & BRIDGES
RIVETED — ARC WELDED
BELMONT INTERLOCKING
CHANNEL FLOOR

Main Office, Philadelphia, Pa.

New York Office, 44 Whitehall St.

Men and Jobs

W. T. Holcomb, who recently succeeded Nevada State Highway Engineer Robert A. Allen, has announced the appointment of **George Egan** as assistant highway engineer in charge of survey and design. Egan moves into the position left vacant by Holcomb's promotion. Also announced is the appointment of **W. R. Parry** as division highway engineer with headquarters at Ely. Parry succeeds **A. G. Kinne,** who resigned to join a private engineering firm at Elko.

Max I. Miller, former district engineer for the Carolina Power and Light Co., with headquarters at Raleigh, N. C., has joined the Bakami Construction and Engineering Co., Inc., at Greensboro, N. C., as vice-president and secretary. He is a graduate of Virginia Polytechnic Institute.

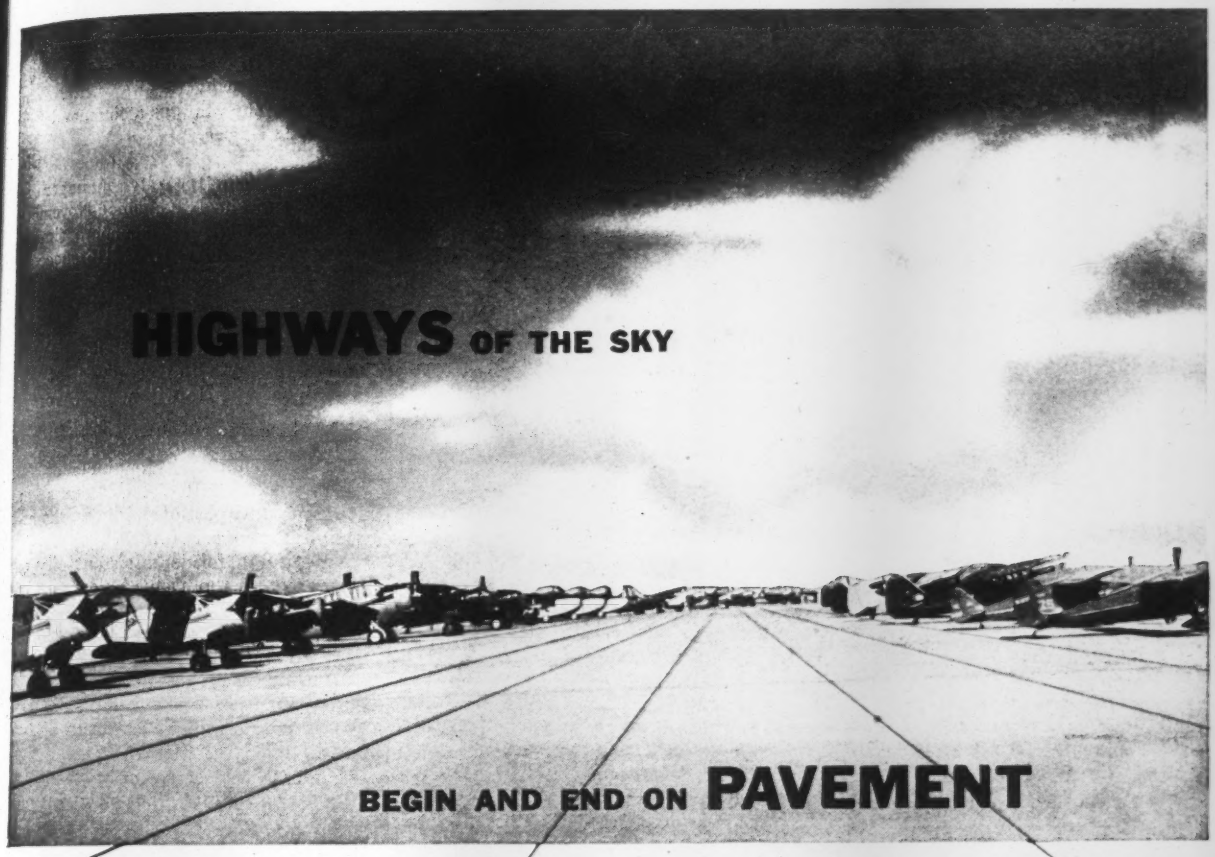
Charles M. Hacker, James A. Ward and Thomas Frutchey of Asheville, N. C., have formed a general engineering business to be known as the Hacker Engineering Corp.

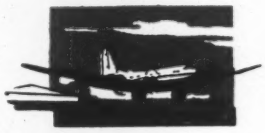
A. H. Douglas, a Saskatchewan university graduate, and engineer in the Provincial Highway Department, Regina Sask., has been named associate professor of civil engineering, University of Saskatchewan.

Irvin Michaelson and **William J. Fedeli** have formed a partnership to practice industrial engineering and architecture under the name of Michaelson and Fedeli with offices in the Fox Building, 1612 Market Street, Philadelphia, Pa. Irvin Michaelson was formerly with The Atlantic Refining Co.

James W. Bainbridge, civil engineer of Seattle, Wash., has opened offices in that city at 12533 Bothell Way.

Francis L. Brown of Fort Edward, N. Y., has been appointed executive assistant of the New York State Department of Public Works by **Charles H. Sells,** state superintendent of public works. Mr. Brown, who is now Washington county superintendent of highways, will succeed **Claude A. Bonaparte,** who became deputy superintendent of public works on July 1. A graduate of Rensselaer Polytechnic Institute, Mr. Brown became resident engineer-inspector for the Public Works Administration with headquarters in Buffalo in 1934, and joined Washington County in 1937. He is also a member





Concrete paved airports, like highways, require joints to protect large pavement areas . . . to allow for normal expansion and contraction of the concrete slabs.

You can reduce maintenance and lengthen the service life of concrete pavement by using *Flintseal**. Here is a *rubber-bearing, thermoplastic, hot-poured* joint-sealing compound that gives you many important advantages.

Flintseal seals joints effectively against infiltration of moisture through repeated cycles of expansion and contraction.

It adheres firmly to concrete . . . without the use of primers.

It maintains resilience . . . does not become brittle and crack in coldest weather, nor will it flow in hot weather.

Flintseal is melted and poured with equipment especially designed to permit fast, safe, economical handling.

We'll be glad to send you data sheets and full information on handling Flintseal.

*Trade-mark

Write:

THE FLINTKOTE COMPANY

Industrial Products Division

30 Rockefeller Plaza, New York 20, N. Y.

Atlanta • Boston • Chicago Heights • Detroit
Los Angeles • New Orleans • Washington • Toronto

FLINTKOTE INDUSTRIAL PRODUCTS

Flintseal

HOT-POURED JOINT-SEALING COMPOUND

THE INSIDE STORY OF PLASTEEL

the PERMANENT ROOFING for industry

STRENGTH through and through

WEATHER SEALED • CORROSION PROOF • MAINTENANCE FREE

Plasteel is more than attractive surface appearance. It's what's *inside* that counts. That's the secret of Plasteel's consistent performance in industry's toughest assignments. Only Plasteel gives you these exclusive built-in features:

STEEL BASE for strength and durability

BOND COAT for a permanent binder plus non-corrosive protection

PLASTICS COAT for air-tight protection against weather and corrosion

MICA FINISH COAT for extra insulation and attractive appearance. Needs no paint, no repairs

. . . everything built in for permanent protection! That's why modern industry and modern architects, engineers and maintenance men insist on Plasteel.

Write for details 47-12

PLASTEEL PRODUCTS CO.

ROOFING • SIDING • VENTILATORS

WASHINGTON, PENNSYLVANIA

of the engineering firm of McFarland and Brown of Glens Falls and Binghamton, N. Y., but will resign both of his present positions before assuming his new post. During the war Mr. Brown served for four years as a commander in the Navy Seabees.

H. L. Burdette, city manager at Kings Mountain, N. C., since November 1940, has resigned to accept a similar position at Hickory, N. C. He succeeds J. D. Ryne who has been in office since July 1946.

Herbert Johnson of Elkhorn, Wis., has been named village engineer of Williams Bay, Wis. He will succeed Joseph Biagi.

A. R. Garnock, city engineer of Eau Claire, Wis., will soon assume the newly- created post of public works and planning engineer for that city. **Neal Bartholomew,** former assistant city engineer and for the past two years associated with **S. P. Hall,** consulting engineer, will become city engineer.

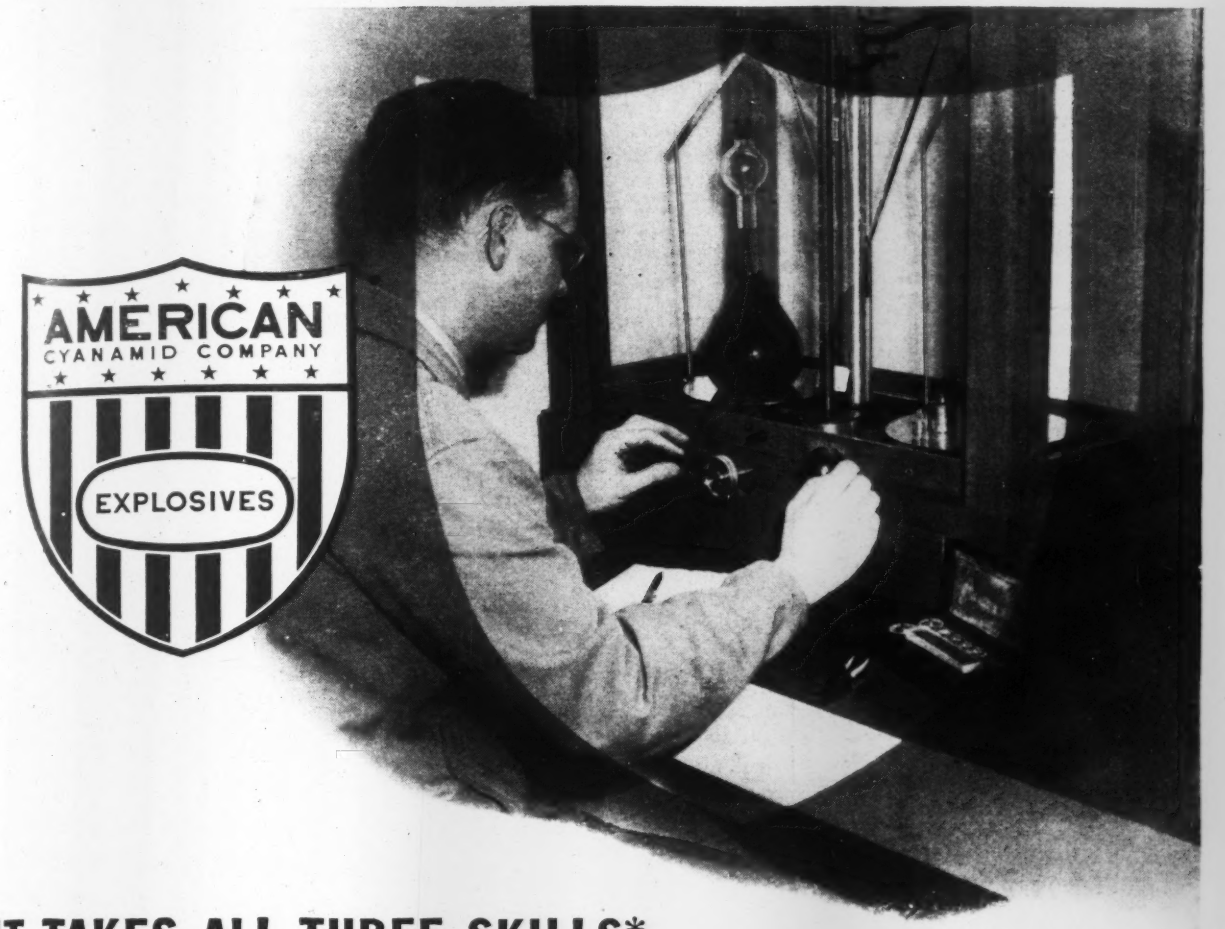
C. E. Lovewell, chief engineer for the Carney Co. of Mankato, Minn., has been named director of sales for the company's cement division.

Walter N. White, district engineer in charge of groundwater investigations in Texas for the U. S. Geological Survey, has retired. Mr. White served the Geological Survey for a period of 36 years in investigations relating to water utilization in many parts of the country, notably in Utah, California, and New Mexico. He has been in charge of the work in Texas in cooperation with the State Board ot Water Engineers since 1929. **William Broadhurst** has been appointed to succeed Mr. White with the title of district geologist. Mr. Broadhurst joined the Texas Board of Water Engineers in 1936 and later served as geologist for the Geological Survey.

Lesley Akers has been appointed Coles County superintendent of highways in Charleston, Ill. Mr. Akers has been with the Illinois Division of Highways both in Effingham and Paris district offices as an engineer.

Paul M. Zander has taken over the administration of the Little Rock, Ark. city engineer's office under temporary appointment. Mr. Zander, a graduate of the University of Illinois, has been employed by the Little Rock office of the United States Engineers.

Jess H. Davis, consulting engineer for the McBean Co., Rochester, N. Y., has been appointed acting president of the Clarkson Memorial College of Technology at Potsdam, N. Y. **Douglas M.**



IT TAKES ALL THREE SKILLS*
TO INSURE MAXIMUM BLASTING EFFICIENCY...

* *Intensive Research*—As a result of intensive research... consistently and successfully applied... only quality chemicals of measured purity go into AMERICAN explosives.

* *Rigid Chemical Control*—Through rigid chemical control and close inspection every step of the way, a complete range of strengths, velocities and densities has been developed to provide an explosive suited to any blasting problem.

* *Technical Skill* and infinite care throughout the manufacturing process assure a high quality product, whatever your blasting requirements.

• *Capable field engineers are available at your call.*

★ HIGH EXPLOSIVES

★ PERMISSIBLES

★ BLASTING POWDER

★ BLASTING ACCESSORIES

AMERICAN CYANAMID COMPANY

EXPLOSIVES DEPARTMENT

30 ROCKEFELLER PLAZA • NEW YORK 20, N. Y.

SALES OFFICES: PITTSBURGH, PA. • BLUEFIELD, W. VA. • SCRANTON, PA. • CHICAGO, ILL. • POTTSVILLE, PA. • MAYNARD, MASS.

Worthington-Ransome Blue Brute Distributors

See ad on page 113 for list of equipment in each line

Worthington-Ransome Distributors

Ala., Birmingham, Construction Equipment Co.
Montgomery, Burford-Toothaker Tractor Co.
Alaska, Anchorage, Airport Mach. & Storage Co.
Ariz., Phoenix, Lee Redman Equipment Co.
Ark., Fort Smith, R. A. Young & Son
Little Rock, R. A. Young & Son
Cal., L. A. Golden State Equip. Co.
San Francisco, Coast Equip. Co.
Colo., Denver, Power Equipment Co.
Conn., Wallingford, Wilhelm-Davies Co., Inc.
Fla., Gainesville Constr. Equipment & Supply Co., Inc.
Fla., Miami, Allied Equip., Inc.
Orlando, Highway Equipment and Supply Co.
Tampa, Epperson & Company
Ga., Atlanta, Tractor & Machinery Company
Ida., Boise, Olson Manufacturing Co.
Ill., Chicago, Chicago Construction Equip. Co.
Ill., Chicago, Thomas Hoist Co.
Ill., Chicago, J. A. Roche
Iowa, Cedar Rapids, McNall Mach. & Supply Corp.
Ky., Harlan, Croushorn, Equip. & Supply Co.
Louisville, Williams Tractor Co.
Mich., Muskegon, Lakeshore Machy. & Supply Co.
Minn., Minneapolis, Phillippi-Murphy Equip. Co
Mass., Cambridge, Field Machy. Co.
Mass., West Springfield, E. G. Edson Co., Inc.
Miss., Jackson, Jackson Road Equip. Co.
Mo., Clayton, The Howard Corporation
Mo., Kansas City, Mach. & Supplies Co.
St. Louis, W. H. Reaves
Montana, Billings, Interstate Truck & Equip. Co.
Helena, Caird Eng. Works
Montana, Missoula, Miller Machinery Co.
Nevada, Elko, C. W. Paul Hardware and Machy. Co.
N. Hampshire, Manchester, R. C. Hazelton Co., Inc.
N. J., No. Bergen, American Air Comp. Corp.
N. M., Albuquerque, Bud Fisher Co.
Roswell, Smith Machy. Co.
N. Y., Albany, Milton-Hale Machinery Co.
New York, Hodge & Hammond, Inc.
New York, Railroad Materials Corp.
Syracuse, Milton-Hale Mach. Co.
N. C., High Point, Smith Equip. Co.
N. D., Fargo, Smith Commercial Body Works, Inc.
Ohio, Cincinnati, Carroll-Edwards & Co.
Dayton, Carroll-Edwards & Co.
Ohio, Toledo, The Kilcorse Machy. Co.
Okla., Oklahoma City, Tattan-Douglas Equip. Co.
Oregon, Portland, Andrews Machinery
Pa., Wilkes-Barre, Ensminger & Co.
Mechanicsburg, Amer. Equip. Corp.
Philadelphia, Metalweld, Inc.
S. C., Columbia, Smith Equipment Co.
Tenn., Knoxville, Dempster Bros., Inc.
Memphis, Independent Tractor Co.
Nashville, Dempster Bros., Inc.
Tex., Amarillo, T. W. Carpenter Equip. Co.
Dallas, Shaw Equip. Co.
Texas, Houston, So. Texas Equip. Co., Inc.
San Antonio, Patten Machy. Co.
Tyler, D. M. McClure Equip. Co.
Utah, Salt Lake City, J. K. Wheeler Mach. Co.
Vt., Barre, A. M. Flanders, Inc.
Va., Richmond, Highway Machy. and Supply Co.
W. Va., South Charleston, Allied Equip. Co.
Wisc., Milwaukee, Drott Tractor Co., Inc.

Ransome Distributors

D. C., Washington, M. A. Doetsch Mach. Co.
La., New Orleans, Ole K. Olson Co.
Md., Baltimore, Stuart M. Christhilf & Co.
Mich., Detroit, Thomas G. Abrams
N. Y., Buffalo, Murray Equip. Co.
N. Y., Rochester, B-G Equip. Co.
O., Cleveland, H. B. Fuller Equip. Co.
Pa., Pittsburgh, Arrow Supply Company

Worthington Distributors

Ind., Indianapolis, Reid-Holcomb Company
La., New Orleans, Wm. F. Surgi Equip. Co.
Md., Baltimore, D. C. Elphinstone, Inc.
Mich., Detroit, W. H. Anderson Co., Inc.
Flint, Gransden-Hall & Co.
N. Y., Buffalo, Dow & Co., Inc.
New York, Air Compressor Rental and Sales
O., Cleveland, Gibson-Stewart Co.
Pa., Allentown, H. N. Crowder, Jr., Inc.
Pittsburgh, Atlas Equip. Corp.
Texas, El Paso, Equip. Supply Co.
Washington, Seattle, Star Machinery Co.
Wyoming, Cheyenne, Wilson Equip. & Supply Co.

Blue Brute Diesels

Worthington Pump and Machinery Corp.

Worthington-Ransome Construction Equipment Division

Holyoke, Massachusetts

McBean, president of the McBean Co., has been named to the board of trustees of the college, representing the alumni.

Vernon Myers has accepted a position with Jenkins, Merchant and Nankivil, Springfield, Ill. consulting engineers. He has served three years as engineer for the Pekin Soil Conservation Project and 14 years with the Illinois Division of Highways.

W. W. Wyke, maintenance supervisor for the North Carolina State Highway and Public Works Commission at Shelby, N. C., has been appointed district engineer for District 3, division 9.

A. J. Orselli, Berkeley, Calif., has been appointed general manager of construction for the W. A. Bechtel Corp., a promotion from his former position as construction manager for the company's northern division. Mr. Orselli, a graduate of the University of California, joined the Bechtel Co. in 1933 after four years of hydro-electric construction. Since 1937 he has specialized in heavy chemical and refinery construction, and in 1944 was sent to Arabia on Bechtel's heavy refinery program there. Later Mr. Orselli was called to Calship, Calif., to help in the shipbuilding program.

Dr. Ralph A. Morgan, assistant director of Florida's Industrial and Engineering Experiment Station, has been promoted to director of the station.

J. Stuart Johnston, research engineer, has been promoted to assistant dean of the University of Florida's College of Engineering.

Howard J. Hansen has been promoted to acting head of the Department of Industrial Engineering of the University of Florida. He is a veteran of World War II during which he served in the Navy and is author of numerous articles and texts on subjects on subjects relating to timber design and preservation.

Frank C. Keefer, who has been with the Public Roads Administration since 1923, has retired. He was engineering draftsman in the Washington, D. C. office. Previous to joining the federal road agency, Mr. Keefer spent seven years with the Forest Service at Albuquerque, N. M., and later nearly five years with the Bureau of Markets, Department of Agriculture.

Ray Raneri, chief of the engineering survey section, sanitary engineering division, U. S. Public Health Service, Washington, D. C., has been transferred to that agency's district office at Kansas City, Mo., where he will pursue stream pollution studies and general sanitation work. During the war, Mr. Raneri was in charge of sanitation facilities at military and war industrial areas. Previously, he was assigned to engineering duties on the Ohio River Pollution Survey, which the Public Health Service carried out in conjunction with the Corps of Engineers. Before joining the USPHS in 1939, Mr. Raneri was a civil engineer with the Public Works Administration and from 1935 to 1937 he was in charge of construction of a $15 million interceptor sewer and sewage treatment plant at Buffalo, N. Y.

C. L. Nelson, Detroit, Mich., has joined the firm of Baxter & Woodman, Crystal Lake, Ill. The firm name has been changed to Baxter, Nelson & Woodman, and will continue as consulting civil and sanitary engineers.

T. E. Hinson has resigned as city manager of Chapel Hill, N.C., after having held the post for the past three years.

J. R. Graham, High Point, N. C., has been named building inspector for that city. For the past ten years he has been construction superintendent for R. K. Stewart & Son, High Point contractors.

Howard H. Burd, sanitary engineer and borough manager of Mechanicsburg, Pa., has been commissioned in the regular army with the rank of major in Field Artillery. Mr. Burd, a graduate of Purdue University, was previously associated with the Pennsylvania State Department of Health.

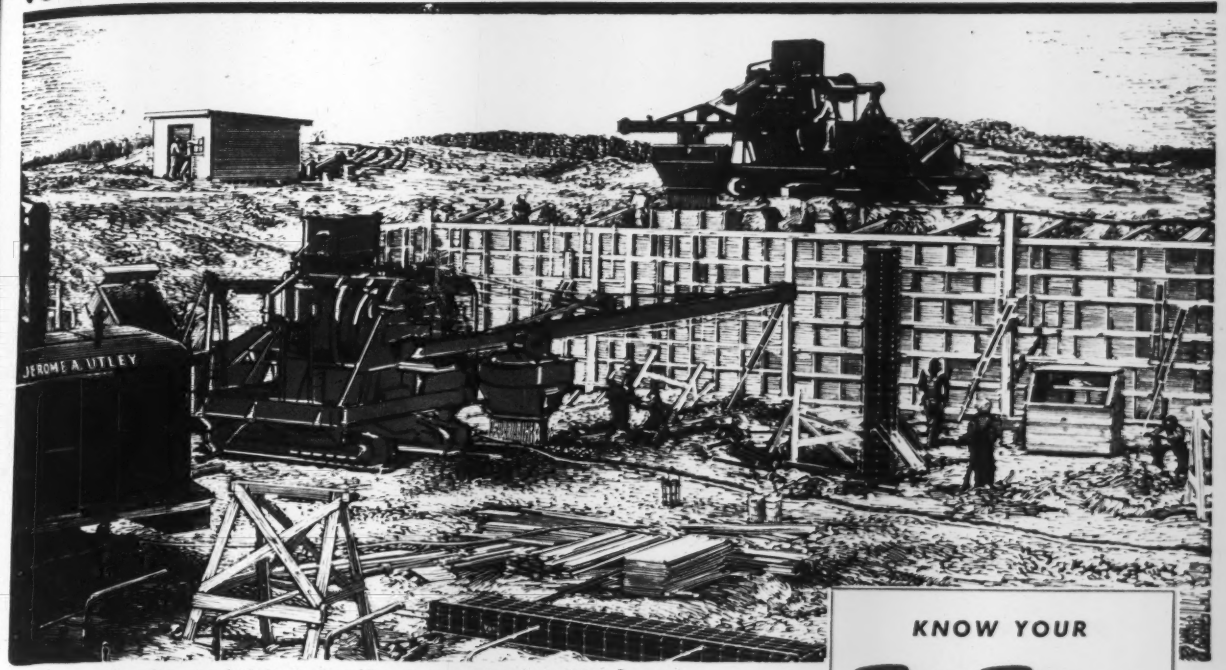
David H. Jones, Huntingdon, Pa., has resigned as resident engineer of the Hollidaysburg district, Pennsylvania state highway department.

Brent Quinn, superintendent of utilities at Cherryville, N. C., has resigned to become manager of the Davidson Electric Membership Corp., which has headquarters at Lexington, N. C. Prior to taking the municipal post at Cherryville, he was general superintendent of construction for several utility companies.

Eugene J. Rago, former Syracuse, N. Y. contractor, will direct street repairs for the city of Syracuse. Mr. Rago was formerly operational director on WPA construction in Syracuse and wartime manager of the post engineer's office for the Army Air Forces at the State Fair. As a contractor, he supervised approximately $3,000,000 worth of street repair projects in Syracuse.

H. D. Dawson, city engineer at Nelson, B. C., Canada, has been appointed municipal engineer for Saanich, Vancouver Island. Mr. Dawson has been a mining and civil engineer in British Columbia for the past 19 years.

TO BEAT YOUR ESTIMATE WHEN THE GOING GETS TOUGH



Two Ransome 34E Single Drum Pavers, owned by J. A. Utley Company, Michigan contractor, delivering concrete directly into forms

Concrete for this big Michigan auto factory site was batched at a central mixing plant. Ground conditions kept truck mixers from getting close to the forms. Bridging the gap with crane-carried buckets would have shot costs up far beyond the estimate. So . . .

Ransome Blue Brute Pavers were called in. From well back of the excavated dirt mounds their "live booms" swung their hydraulically-controlled buckets directly over the forms. Spillage was eliminated by the bucket's hydraulic shut-off when the forms were filled . . . Another construction problem solved!

More About the "Live Boom"

It spreads over a wider area with every swing, eliminating hand shovelling . . . Boom can be elevated to 9-ft. clearance under bucket, while paver concretes retaining walls, etc., and lays the slab — all in one operation. *Only Ransome Pavers include the "live boom" as standard equipment.*

Get the Whole Story

Many other advanced features show why 34E's — Single Drum and Dual Drum — are preferred equipment on big construction jobs . . . highways, dams, reservoirs, airport runways, foundations, piers . . . saving costs with every cubic foot of concrete placed. Write for facts on how these famous Ransome Pavers can make more profits for you with their high-speed operation and their low maintenance cost . . . proving *there's more worth in a Blue Brute.* R7-5

KNOW YOUR

BLUE BRUTES

Your Blue Brute Distributor will be glad to show you how Worthington-Ransome construction equipment will put your planning on a profitable basis. His name is listed on Page 112.

RANSOME EQUIPMENT

Pavers, Portable and Stationary Mixers, Truck Mixers, Pneumatic Placing and Grouting Equipment and Accessories.

WORTHINGTON EQUIPMENT

Gasoline and Diesel Driven Portable Compressors, Rock Drills, Air Tools, Self-Priming Centrifugal Pumps and Accessories.

WORTHINGTON

Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division, Holyoke, Mass.

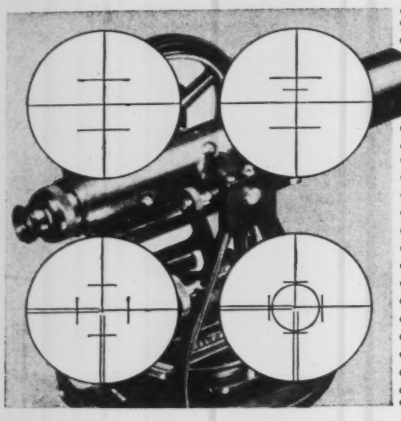
BUY BLUE BRUTES

IF IT'S A CONSTRUCTION JOB, IT'S A BLUE BRUTE JOB

To offer owners year-round utility Minneapolis-Moline has designed the model RTI and UTI tractors to accommodate a wide variety of attachments . . . Dozers, snow plows, material buckets, lifting forks, winches, and many other tools make MM industrial tractors the hardest workers on any construction job . . . New extra heavy duty front wheel and axle construction now provides increased strength for lifting larger pay loads.

See Your Nearest M-M Dealer, Distributor or Write

MINNEAPOLIS-MOLINE
POWER IMPLEMENT COMPANY
MINNEAPOLIS 1, MINNESOTA



Here's why Gurley Instruments now feature quick-reading glass reticles...exclusively

Study these *new* reticle patterns. Think of them in your Gurley transit. They'll make your surveying job easier.

Here's the latest advance in engineering instruments—glass reticles in patterns to suit all surveying needs—developed by Gurley for added efficiency and accuracy, and incorporated in all new Gurley instruments. Write today for Bulletin No. 50. W. & L. E. Gurley, Union Plaza, Troy, N. Y.

GURLEY

Scientific and Surveying Instrument Makers
Since 1845

Engineering School News

(Continued from page 113)

At an informal ceremony June 26 ground was broken for two new buildings at Stevens Institute of Technology, Hoboken, N. J..—The Kidde Memorial Laboratory of Physics and the Peirce Memorial Laboratory of Metallurgy. The buildings, costing approximately $700,000, will complete the 3-unit science center at Stevens.

Once a week on Thursday mornings this summer seminar lectures in engineering mechanics are being given at the technological institute of Northwestern University, Evanston, Ill. They are open to the engineering profession without charge. The dates, subjects and lecturers for the last six weeks are as follows:

July 26—"Criteria of Dynamic Instability," J. P. Den Hartog, Massachusetts Institute of Technology.

Aug. 2—"Vibration Measurements and Their Interpretation," J. Ormondroyd, University of Michigan.

Aug. 9—"The Fatigue Strength of Metals," H. F. Moore, University of Illinois.

Aug. 16—"Some Aspects of Mechanical Shock," R. D. Mindlin, Columbia University.

Aug. 23—"The Buckling Strength of Actual Structures," Lloyd H. Donnell, Illinois Institute of Technology.

Aug. 30—"Fundamentals of Stress Analysis by X-Rays," Charles S. Barrett, University of Chicago.

Graduate engineers will be in demand for the next several years, guidance counsellors of Western New York secondary schools were told at the recent annual guidance counsellors' conference by the University of Buffalo.

Prof. H. Oakley Sharp, of Rensselaer Polytechnic Institute, has been named chairman of a joint committee for New York State in a nationwide movement to bring about more uniformity in the surveying and mapping of lands. Cooperating are the American Society of Civil Engineers, American Society of Photogrammetry, American Congress on Surveying and Mapping, and American Society for Engineering Education.

Professor Sharp said that for the "improvement of techniques, equipment, uniformity and other conditions that apply," it was hoped to bring together, in annual state conferences, engineers employed by cities, counties and state departments, as well as those in private practice and in teaching.

Elections and Activities

John L. Burnett, of Tampa, superintendent of filtration at the Tampa water plant, has been elected president of the Florida Water and Sewage Works Operators Association. Charles H. Carothers, of Miami, sanitary engineer for the Pratt General Hospital, was named president-elect. Mrs. Patricia Sherwood of Cypress Landing, Fort Lauderdale, became secretary-treasurer. E. Earls, chemist and superintendent of the water treatment plant at St. Augustine, was elected a member of the board of governors.

Kenneth Lackey, Gary, Ind. park superintendent, was elected president of the Indiana Municipal Park and Recreation Association at the annual meeting held at Gary, Ind., on June 19. Roger Winters, superintendent of Terre Haute parks, was elected vice-president.

K. Mark Cowen, Indianapolis superintendent of recreation, was named the new chairman of the board of directors, succeeding Paul V. Brown, director of Indianapolis parks. Other members of the board are R. Wayne Cunningham, Hammond; Martin Nading, Fort Wayne; Jerry T. Femal, Bloomington; T. M. Shirley, Columbus; and Orville Roseberry, Anderson.

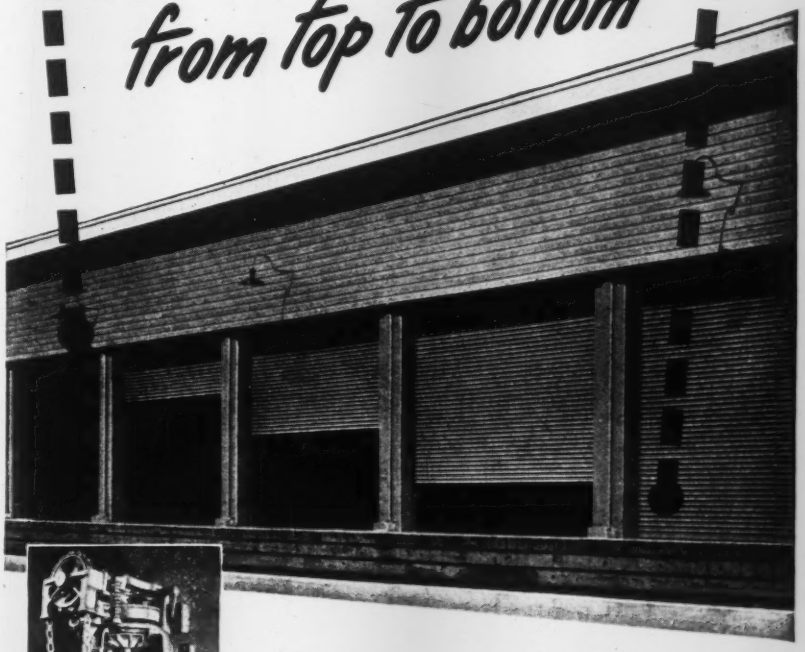
Thomas R. Jacobi, Indianapolis city engineer, was recently elected president of the Indiana Society of Professional Engineers, succeeding Carl E. Vogelsang, chief engineer for the State Highway Commission. Col. Chester Lichtenberg, Fort Wayne, was elected first vice president; F. B. Mendenhall, Indianapolis, second vice president; Robert W. Heider, Indianapolis, secretary; John B. Wilson, Indianapolis, executive secretary; Fred L. Ashbaucher, Indianapolis, treasurer; M. W. Cameron, Indianapolis, national director; and C. S. McKee, Vincennes; Eugene Easley, Indianapolis; Prof. Harry Solberg, Purdue University; and Joseph Wysong, East Chicago, state directors.

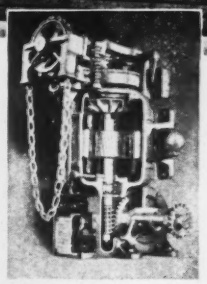
Charles Larsen, Lakeland, Fla. city manager, has been elected president of the newly-formed Florida Society of Professional Engineers. Other officers include Stephen A. Derry, Gainesville, vice-president, and William E. Godfrey, Lakeland, secretary.

R. M. Keatts, manager of the Keatts Thermal Equipment Co., Columbus, Ohio, has been installed as president of

KINNEAR ROLLING DOORS

GREATER EFFICIENCY from top to bottom





The rugged Kinnear Motor Operator above can be added to any Kinnear Rolling Door for maximum speed and ease of operation. Push button controls (below) may be located at any desired point.

● Opened or closed—or in action—Kinnear Rolling Doors offer advantages that quickly prove their greater efficiency "from top to bottom."

They open *straight upward*, coiling compactly *out of the way*, above the doorway. They *clear* the entire doorway, and remain *out of reach of damage* by wind or vehicles.

They open and close without requiring any floor or wall space for operation—all surrounding space remains fully usable *at all times.*

When closed, Kinnear Rolling Doors offer the extra protection of *all-steel construction*—against wind and storm damage . . . against theft or intrusion . . . against fire or explosion.

Kinnear Rolling Doors are built in any size, for installation in new or old buildings. Write for new catalog.

THE KINNEAR MANUFACTURING CO.
1820-40 Fields Avenue • Columbus 16, Ohio
1742 Yosemite Avenue, San Francisco 24, Calif.
Offices and Agents in All Principal Cities

Saving Ways in Doorways
KINNEAR ROLLING DOORS

How to relax, when something's needed fast!

Even if your suppliers are thousands of miles away, and you need parts and supplies *right now* — let others do the worrying, but never you. Specify Air Express and get delivery in a matter of *hours.*

Air Express goes coast-to-coast overnight, and speeds up to five miles a minute insure same-day delivery between many U.S. towns and cities. Use it regularly, and you'll be paid off in greater customer satisfaction and smooth-running, efficient operation. To solve overseas shipping problems, investigate fast, frequent inexpensive International Air Express.

Specify Air Express-it's Good Business

- Low rates—special pick-up and delivery in principal U.S. towns and cities at no extra cost. • Moves on all flights of all Scheduled Airlines.
- Air-rail between 22,000 off-airline offices.
- Direct air service to and from scores of foreign countries.

Just phone your local Air Express Division, Railway Express Agency, for fast shipping action . . . Write today for Schedule of Domestic and International Rates. Address Air Express, 230 Park Ave., New York 17. Or ask for it at any Airline or Railway Express Office. Air Express Division. Railway Express Agency, representing the Airlines of the U.S.

AIR EXPRESS

AIR EXPRESS GETS THERE FIRST

Fastest delivery — at low rates

65 lbs. of machine parts in Louisville had to get to Dallas *fast.* Picked up at 5 PM on the 25th, they were delivered at 7 AM on the 26th. For complete door-to-door service, the Air Express charge was only **$15.96!**

the Franklin County chapter, Ohio Society of Professional Engineers. Myron T. Jones, Columbus consulting engineer, was elected vice president and Eugene W. Davis, Columbus civil engineer, was renamed secretary-treasurer. Robert F. Werner, Division Six engineer for the Ohio State Highway Department, was named director for a three year term. Directors elected for a one year term include: Guy Elbin and Arliss C. Allen, consulting engineers; Charles P. Smith, state; John W. Leech, utilities; Robert N. Tucker, municipal; and Lloyd W. Gansha, industrial.

Maurice J. Aykroyd, civil engineer, has been elected president of the Dominion Council of Professional Engineers, a consultative and advisory federation of eight provincial associations with registrations totaling over 10,000 professional engineers in all parts of the dominion.

M. B. Killian, San Antonio, Texas, was elected president of the Texas Highway Branch, Associated General Contractors of America recently, succeeding Herman Brown. F. W. Heldenfels of Corpus Christi is the new vice-president and Charles H. Newell of Austin was re-elected secretary.

J. Murray Muir assumed office recently as secretary-treasurer of the Association of Professional Engineers of the province of Ontario, Canada.

W. H. H. Putnam, assistant manager of the Birmingham, Ala. Waterworks Co., was elected president of the recently-organized Alabama Water and Sewage Works Association. Other officers named were: Tom Collins, manager of the Ozark waterworks, vice-president; Alex O. Taylor, director of engineering extension at Alabama Polytechnic Institute, secretary; Prof. Gilbert H. Dunstan, associate professor of sanitary engineering at the University of Alabama, treasurer, and Charles White, engineer of the State Board of Health, editor.

At the annual meeting recently held at Des Moines, Iowa, of the Iowa State Association of County Officials, division presidents were elected. For the county engineers' division, La Verne J. Schultz, Dubuque county engineer, was elected president; P. A. Mickel, Montgomery county engineer, vice-president; and Frank Laing, Polk county engineer, secretary-treasurer.

Comdr. Herbert M. Shilstone, Jr., one of the organizers of the Seabees, has been elected commanding officer of the Civil Engineers Reserve Club at Houston, Tex.

Manufacturers' Activities

A. H. JONES has been appointed director of the export office of the Gardner-Denver Co. in New York City. He was also elected vice president of the newly formed Gardner-Denver Western Hemisphere Co. in New York.

WHITE ENGINEERING & MFG. CO., INC., Rochelle Park, N. J., manufacturers of White portable vapor steam cleaning machines, announced the appointment of H. Cliff Corwin as sales manager.

THE ACME RUBBER MANUFACTURING CO., Trenton, N. J., has announced the promotion of L. J. Amsdell to the position of eastern sales manager with headquarters in New York.

BRIG. GEN. HUGH C. MINTON, who was awarded the Distinguished Service Medal for his able direction of the Army Service Forces' production division during World War II, will become production manager of Koppers Company, Inc., Pittsburgh, Pa.

LEE B. GODFREY, formerly of Atlanta, Ga., has been made director of sales for the Signal Mountain, Tenn., division of the Georgia Portland Cement Co., Chattanooga. He succeeds the late Irving F. Sisson.

Better to service those industries in Northwestern Ohio which have heavy materials handling problems, the OHIO EQUIPMENT CO., INC., Cleveland, representatives for The Yale & Towne Mfg. Co., has added Charles F. Yarham to its sales-engineering organization.

C. L. CUMMINS, founder in 1919 of the Cummins Engine Co., Inc., Columbus, Ind., was elected chairman of the board of directors, and J. I. Miller was elected president at the 1947 annual meeting of stockholders and directors.

Announcement of the appointment of DRAVO-DOYLE CO., Pittsburgh, as national distributors for the Hercules Turn-O-Matic cement box has just been made by Hercules Steel Products Corp. Galion, Ohio, manufacturers of this widely-used product.

WILLIAM J. HAZELTINE, formerly vice-president and sales manager of the Buffalo Springfield Roller Co. has joined the Galion Iron Works & Mfg. Co., as special representative of the roller division.

ESCO 2¼-yard all-cast dipper, with manganese steel dog leg bail working on 80D Northwest rock shovel. Location at Kortes Dam in Wyoming; Morrison-Knudsen Company is contractor.

How to "SOFTEN UP" tough digging jobs!

The rock in the picture above tells the story of a typical job for *ESCO* dipper buckets. And repeat purchases of *ESCO* buckets by contractors all over the world tell the story of how well these buckets stand up to their job of "softening up" tough going.

Regardless of how tough the job may be, operators find that their *ESCO* buckets give them

Maximum payloads
Efficient, fast digging
Long life on the job
Minimum maintenance and loss of time

These advantages are built into *ESCO* buckets. Parts subject to wear and shock are made of *ESCO Manganese Steel* which hardens and polishes with use while retaining all its rugged strength and shock resistance.

Practical excavating engineers design *ESCO* buckets. They place strength where it is needed, eliminate unnecessary weight, provide for clean, full bite and quick, complete discharge.

Detailed Information Available

ESCO buckets are made in two types—the all-cast for extremely hard service, and the lighter cast-welded type for general purpose work. For your information, complete data on both buckets including materials used, construction details, sizes, etc., is available in *ESCO* catalogs 114B and 156. Get your copy from your nearest *ESCO* representative, or fill in and mail the coupon below.

ESCO Manganese Steel
FOR ULTIMATE ECONOMY

ELECTRIC STEEL FOUNDRY
2167 N. W. 25th AVENUE, PORTLAND 10, OREGON

OFFICES

CHICAGO, ILLINOIS — NEW YORK CITY, N.Y.
EUGENE, OREGON — SAN FRANCISCO, CALIF.
HONOLULU, T. H. — SEATTLE, WASH.
LOS ANGELES, CALIF. — SPOKANE, WASH.

IN CANADA — *ESCO* LIMITED, VANCOUVER, B. C.

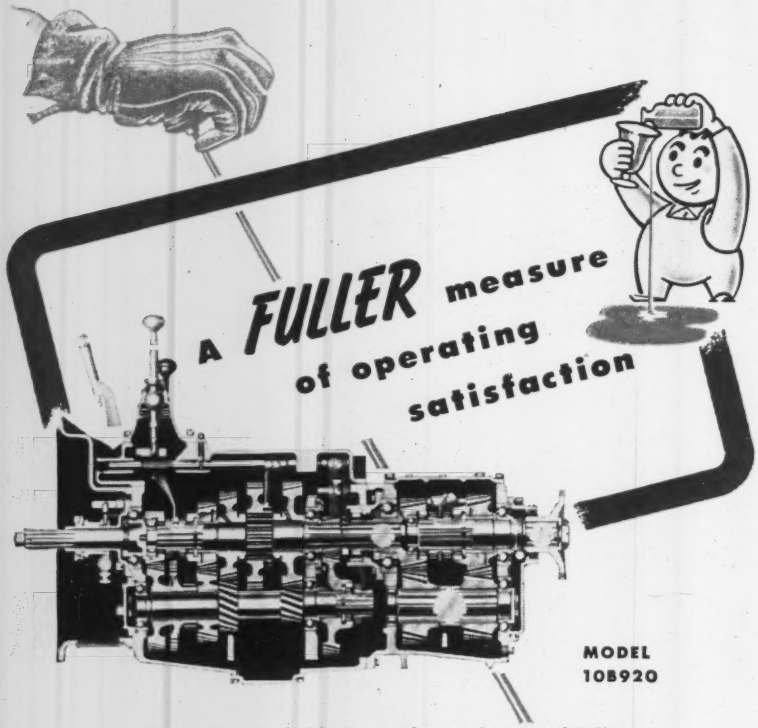
ELECTRIC STEEL FOUNDRY
2167 N.W. 25th Avenue
Portland 10, Oregon

Please send catalog 114B and 156 to:

Name_____

Address_____ Zone____

City_____ State____



Every step in the design and manufacture of Fuller Transmissions and Auxiliaries has a single purpose: to give you, the fleet operator, the greatest amount of satisfaction from the operation of the Fuller Heavy-duty Transmission in your rig.

Sound design, precise workmanship, and laboratory tested materials are found in every Fuller Transmission. These are important reasons why Fuller Transmissions shift smoothly . . . run quietly . . . require little maintenance . . . operate efficiently, month after month. They are reasons why fleet operators everywhere report a *Fuller* measure of operating satisfaction from these proved-in-the-field and geared-for-the-job Transmissions.

FULLER MANUFACTURING CO., TRANSMISSION DIVISION
KALAMAZOO 13F, MICHIGAN
Unit Drop Forge Division, Milwaukee 1, Wisconsin
Western District Office (Both Divisions): 577 14th Street, Oakland 12, California

Fuller TRANSMISSIONS

MacArthur

37 YEARS INSTALLING PILES
OF EVERY TYPE

CAST-IN-PLACE CONCRETE COMPOSITE
STEEL SECTIONAL PIPE TIMBER
SOIL AND ROCK BORINGS

MacARTHUR CONCRETE PILE CORPORATION
18 EAST 48th STREET, NEW YORK 17, N. Y.
BOSTON • CINCINNATI • NEW ORLEANS

Manufacturers' Publications

Electric and Pneumatic Controls—"Industrial Control Devices". Catalog No. 8302, contains important information on electric and pneumatic automatic control systems. Accurate and dependable industrial control devices and safeguards are described, with complete schematic diagrams, dimensional drawings, photographs, specifications, range charts, etc.—*The Brown Instrument Co., Wayne & Roberts Aves., Philadelphia 44, Pa.*

Prefabricated Insulated Pipe Units Specifications—Designed to be of practical use is a booklet of specifications for underground pipe distribution systems employing prefabricated insulated pipe conduit. It is a comprehensive compilation of data arranged in convenient tabular form with supplementary diagrams and charts; included are tables of dimensions for one or more conduits in one trench, maximum conduit capacities of wrought iron and steel pipe sizes, and standard prefabricated expansion loop details. Loop dimensions expansion charts for both steel and wrought iron pipe are shown. —*The Ric-wiL Co., Cleveland, Ohio.*

Spherical Storage Vessel—8 p. booklet, "The Hortonsphere" describes the reduction of evaporation losses from highly volatile liquid by storing them under pressure. Correct storage pressure required to prevent standing losses from volatile liquids can be read directly from the chart. There is also a chart for determining the vapor pressure of the product to be stored at a given temperature. Gauging methods are described and photographs of three typical gauging units are shown.—*Chicago Bridge & Iron Co., 332 South Michigan Ave., Chicago 4, Ill.*

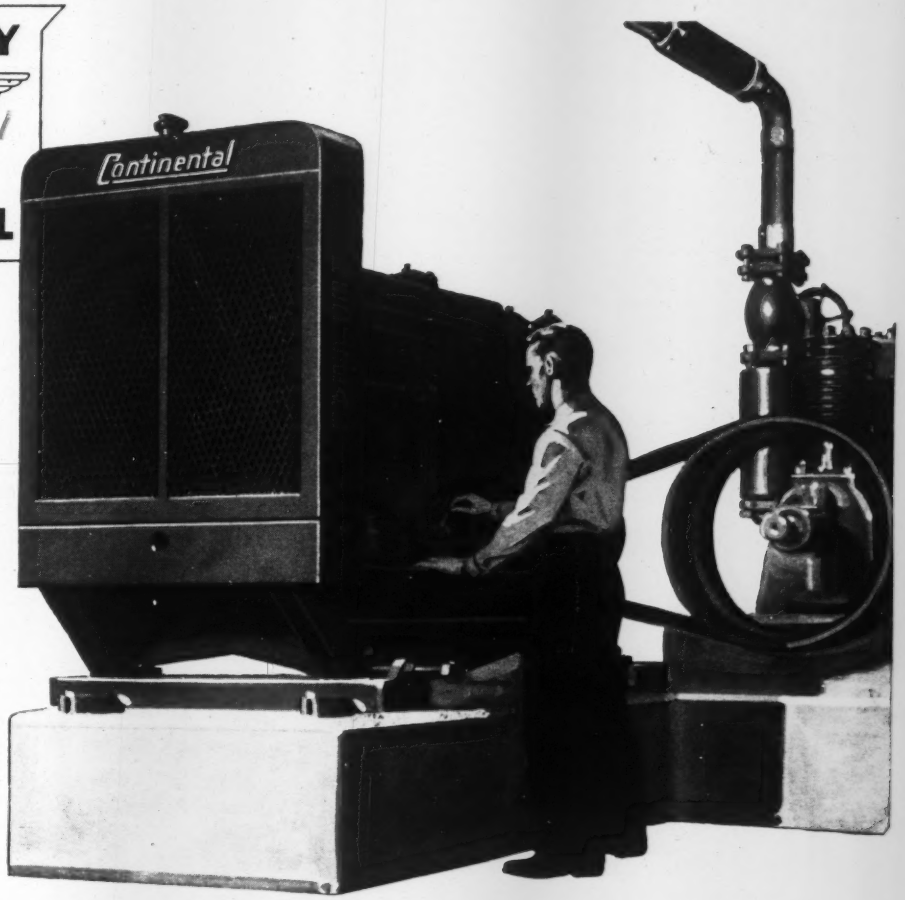
Flow Rates—A new bulletin, greatly augmented, describing Flowrator instruments for measuring flow rate of liquids and gases includes elaborate descriptions and illustrations of instruments, assembled and disassembled. Numerous new accessories are shown. Details of front and rear panel mounting, rear lighting arrangements, steam heating coils, and alarm devices are also given.—*Department 4X-C, Fischer & Porter Co., Hatboro, Pa.*

Roof Paint—A 22-p. brochure describes the insulative and protective

POWER BY

Red Seal Engines

CONTINENTAL



THE RED SEAL R-600 *is one of the larger engine series in the Continental line. These engines have up to 602 cu. in. displacement and deliver over 140 brake h.p. at 2000 r.p.m. for intermittent duty and over 115 h.p. at 1800 r.p.m. for continuous duty.*

RED SEAL ENGINES
BUILT FOR THE JOB!

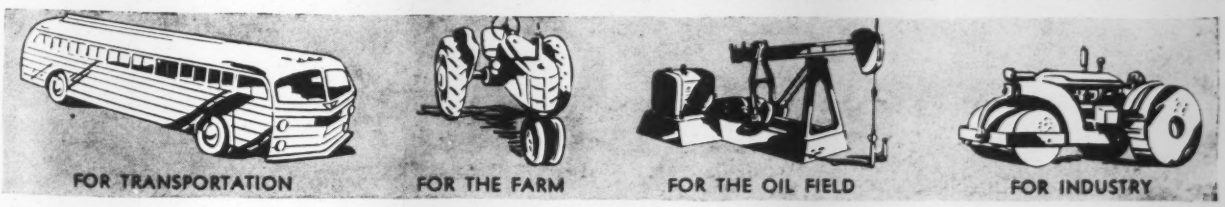
At any given horsepower, there are up to 20 Red Seal engines from which to select ***the*** model that is built for the job. By specifying the Red Seal engine with not only the right power ***output,*** but the right power ***characteristics*** for an application, you get maximum economy and performance. Heavy-duty Red Seal Industrial engines are available in 4- and 6-cylinder models — L-head or overhead-valve types — for operation on all types of fuels — from ½ to 140 horsepower.

There are *more* Continental engines, for *more* jobs in construction and industry, and *more are on the way.*

Continental Motors Corporation

MUSKEGON, MICHIGAN

45 YEARS' SPECIALIZED EXPERIENCE BUILDING ENGINES FOR TRANSPORTATION, AVIATION, INDUSTRY AND THE FARM



FOR TRANSPORTATION | FOR THE FARM | FOR THE OIL FIELD | FOR INDUSTRY

When you think of
Air Entraining Concrete
think **DAREX* AEA**

The Air Entraining Agent for Controlled Air

Easy to use • Inexpensive •
Improves Workability
and Placeability •
Speeds up Finishing •
Improves Concrete Durability

DAREX AEA

DEWEY AND ALMY CHEMICAL COMPANY
CHICAGO, ILL. CAMBRIDGE, MASS. OAKLAND, CAL.

*T. M. REG U.S. PAT. OFF

The
PHOENIX BRIDGE CO.
BRIDGES and BUILDINGS
General Office and Works
Phoenixville, Pa.
District Offices
New York, N. Y. Boston, Mass.
Washington, D. C.

DRILLING CONTRACTORS
DIAMOND AND SHOT CORE BORINGS — DRY SAMPLE BORINGS
Foundation Testing for Bridges, Dams and all Heavy Structures
Also
Manufacturers of Diamond and Shot Core Drills, Accessories and Equipment
SPRAGUE & HENWOOD, Inc.
Scranton, Pa. Dept. E, U. S. A.

qualities of Gilsalume, a newly developed gilsonite asphalt aluminum roof paint. Gilsalume is said to reflect to 70 percent of the sun's destructive rays and reduces interior temperatures as much as 15 degrees.—*Lynn-Fieldhouse, Wilkes-Barre, Pa.*

Radio Frequency Heating—(8-p. technical bulletin) Covers principles, advantages, equipment and types of this method of gluing wood. Recommended glue mixtures are listed.—*Casein Co. of America, Division of Borden Co., 350 Madison Ave., New York 17, N. Y.*

Industrial Piping—A new economy in industrial piping which the Nibcoloy stainless steel and nickel alloy fittings make possible is emphasized in Catalog No. 901. Three methods illustrating the ease of joining the fittings to produce smooth inner walls which permit an undisturbed flow of liquid are shown. Roughing-in dimensions and prices for the complete series of Incoonel, Monel, Nickel and Stainless Steel 304, 347 and 316 fittings from $\frac{1}{4}$ in. O. D. to 4 in. O. D. are listed.—*Northern Indiana Brass Co., Elkhart, Ind.*

Laminated Plastics—A new 64-p. booklet on Textolite laminated plastics contains complete information on the manufacture, application, engineering and properties of all types of Textolite laminated applications. Other sections of the booklet contain information on Textolite tubes and rods, bearing materials, silent gears, decorative surfaces, translucent sheets, nameplates, molded-laminated plastics, low-pressure laminated plastics, methods and fabricating laminates and ordering instructions.—*Chemical News Bureau, General Electric Co., Pittsfield, Mass.*

Precision Instruments—(116-p. catalog) Contains descriptions and specifications for levels, transits, jig collimators, transit-theodolites, alidades and plane tables. Cross-section drawings and photographs are included.—*C. L. Berger & Sons, Inc., 37 Williams St., Roxbury, Boston 19, Mass.*

Lumber and Wood Using Industries—(12-p. bulletin) Describes research facilities for improving present wood products and developing new uses. Company's laboratory facilities are outlined, with partial listing of 25 different fields of research carried on for individual companies and trade associations.—*Timber Engineering Co., 1319 18th St., Washington 6, D. C.*

Metal Framing and Concrete Inserts—(Six bulletins) Cover various products of company, including: (1)